39TH CONGRESS, 1st Session. } HOUSE OF REPRESENTATIVES. { Ex. Doc. No. 75.

REPORT

OF THE

SUPERINTENDENT

OF THE

UNITED STATES COAST SURVEY,

SHOWING

THE PROGRESS OF THE SURVEY

DURING

THE YEAR 1865.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1867.

In the House of Representatives, *April* 10, 1866.

Resolved, That there be printed two thousand and five hundred copies (extra) of the report of the Superintendent of the United States Coast Survey for the year 1865; of which one thousand shall be for distribution by the Superintendent of the Coast Survey, and one thousand five hundred for the use of the members of this house.

In the Senate, *April* 10, 1866.

Resolved, That there be printed of the report of the Superintendent of the United States Coast Survey for the year 1865 one thousand copies extra for the use of the Senate, and one thousand copies for distribution by the Superintendent of the Coast Survey.

LETTER

FROM

THE SECRETARY OF THE TREASURY,

TRANSMITTING

THE ANNUAL REPORT OF THE SUPERINTENDENT OF THE U. S. COAST SURVEY FOR 1865.

TREASURY DEPARTMENT, *March* 24, 1866.

SIR: I have the honor to transmit, for the information of the House of Representatives, a report made to this department by A. D. Bache, LL. D., Superintendent of the United States Coast Survey, on the progress of that work during the year ending November 1, 1865, and an engraved sketch showing the general progress made in the survey of the Atlantic, Gulf, and Pacific coasts; also the manuscript map of progress brought up to the same date, in accordance with the act of Congress approved March 3, 1853.

I have the honor to be, very respectfully,

H. McCULLOCH,
Secretary of the Treasury.

Hon. SCHUYLER COLFAX,
Speaker of the House of Representatives.

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REPORT.

COAST SURVEY OFFICE,
Washington, D. C., December 16, 1865.

SIR: I have the honor to report, in accordance with law and the regulations of the Treasury Department, on the progress made in the survey of the coasts of the United States during the year from November 1, 1864, to November 1, 1865.

During the rebellion the usual field operations of the coast survey were necessarily somewhat restricted. In the southern sections they were carried on only as far as requisite and practicable in connection with the operations of the naval forces. In most cases when the assistants and aids have served with military or naval commands, the working parties have been furnished from the command, and only the pay and subsistence of the officers of the survey have been chargeable to the coast survey appropriations. So also the vessels of the survey, when serving with squadrons, have been supplied with coal and kept in repair by the Navy Department.

Under these circumstances a corresponding reduction in the estimates for the work was made, which, from considerations of economy, was extended to the work on the western coast. The appropriations, amounting to over four hundred and fifty thousand dollars in 1860, were reduced, in accordance with the estimates submitted, to about three hundred thousand dollars during the several years of the war.

The general progress made in the survey of the coast, and in the development of its hydrographic features, is best shown by the sketch which has been given from year to year with the annual reports. That sketch accompanies this report as No. 25 in the list of maps and charts, which give the most recent results of the survey. The large manuscript map presented from year to year, in accordance with the act of Congress approved March 3, 1853, shows the same particulars in more detail. By either of these maps the condition of the work in its general features can be seen at a glance.

DIVISIONS OF THE REPORT.

The usual subdivision of the annual report into three parts is retained. Part I, as heretofore, will contain statements of particulars connected with the field and office work of the survey—such as estimates, progress, and remarks on special results. Part II will contain notices of the work done by each party in the field and the details of occupation in each branch of the office. In the Appendix (Part III) will be given general lists illustrating the field and office work, and papers descriptive of methods and processes connected with geodetic operations. These last, being of special interest, will be briefly reviewed in Part I of the report.

PROGRESS DURING THE SURVEYING YEAR 1864–'65.

The following is a brief sketch of the progress made during the past year. While the war continued, a number of parties were connected with government commands, and rendered efficient aid in naval and military operations, as during the preceding years.

Four parties were attached to the South Atlantic blockading squadron, so as to be available also for service in the military departments of the south. The labors of these comprise a complete resurvey of the bar and channels leading into Charleston harbor; a survey of the inside water passages between St. Helena and Port Royal sounds, and a survey of Broad river and the Whale branch to Port Royal ferry; of the Wilmington and Thunderbolt rivers, and other communications between the Savannah river and Ossabaw sound, including among them the dependencies of Wassaw sound; a survey of the rebel defences of Charles-

ton and Savannah, the latter embraced within an extended reconnaissance of all the approaches to that city. In this same district, and under instructions of the Light-house Board, the parties have replaced lights, beacons, and buoys, as their places were re-occupied by the national forces. The entrance to Darien was examined and buoyed, for the transportation of released Union prisoners.

Four topographers of the coast survey accompanied General Sherman's army in the march from Savannah to Goldsboro', and rendered effective aid in making reconnaissances.

Two parties were connected with the North Atlantic blockading squadron. One of these, after assisting in the operations against the rebel defences of Wilmington, North Carolina, made a complete resurvey of both entrances to the Cape Fear river. The other relighted and buoyed the channels of that river, as also those leading into Beaufort, North Carolina, which was then important as the rendezvous of the squadron for supplies.. After the close of hostilities the same party completed the hydrographic survey of the Cape Lookout shoals, and continued off-shore soundings along the coast of North Carolina.

A topographical survey of the banks of the Potomac river, from the vicinity of Washington to Harper's Ferry, has been made by a party attached to the middle military department; and two other parties have extended the detailed surveys of the approaches to Washington and Baltimore. One topographer was continued on service with the army operating in the valley of Virginia, and furnished the results of reconnaissances at Flint Hill and Cedar creek, after serving in battle at both places. Another remained on duty with the army of the Tennessee, and has mapped the defensive ground and approaches to Lookout mountain, and extended the survey of the battle-field of Chickamauga.

In connexion with the Mississippi squadron, a party of coast survey officers have made a valuable reconnaissance map of over two hundred and fifty miles of the Tennessee river, or from its mouth to the Muscle shoals; a map of the lower Ohio from Paducah to Cairo; and a map of about one hundred and fifteen miles of the course of the Mississippi river from Cairo up to St. Mary's. This work necessarily ceased when, owing to the reduction of the squadron in the western waters, a vessel was no longer available for the uses of the party. It may be hoped, however, that the great and obvious usefulness, in a national point of view, of a reliable map of the Mississippi river may lead Congress to make a special appropriation for the further prosecution of that work. A stretch of forty-five miles of the river was mapped last year above and below Vicksburg, and thus an important part of the Mississippi has already been surveyed without involving any public expenditure that would not otherwise have been incurred.

In the regular progress of the survey of the Atlantic coast, parties have been at work on the coast of Maine during the summer and autumn, in Passamaquoddy, Gouldsborough, Frenchman's and Penobscot bays, in Muscongus sound, and in the Medomak, Damariscotta, and New Meadow rivers; on the shores of Narragansett bay and its dependencies, in Rhode Island; and on the coast of New Jersey. The connection of the primary triangulation in Sections I and II has been completed by the Superintendent's party.

On the western coast, the triangulation between San Francisco and Monterey bays has been completed; that of Suisun bay has been continued; the topography between Point Año Nuevo and Point San Pedro, and the off-shore hydrography south of San Francisco entrance, have been continued, and the topography and hydrography of Koos bay have been completed.

Under the head of sections geographically arranged, the details of work done by the surveying parties will be found in Part II of this report, followed by a summary of the work done in the office during the year.

ESTIMATES.

The estimates for the deficiency in appropriations for the survey of the coast for the fiscal year 1865–'66' together with those for the fiscal year 1866–'67, are herewith appended.

In regard to the deficiency it is only necessary to state that the late Congress failed to pass the general appropriation bill, in which the items for the coast survey were included. No appropriation, therefore, was made for the fiscal year 1865–'66. The work has been continued with the unexpended balance of previous appropriations, and some aid afforded by the Treasury Department. During the progress of the bill in the late Congress, the estimates for the work of the survey had been approved by both houses, and the amounts now estimated for are intended to meet the expenditures for the remainder of the present fiscal year, upon the same scale of appropriation.

An early resumption of the work on the coast of the southern States is contemplated, and is provided for on a moderate scale in the estimates herewith presented.

The table below gives the amounts estimated to supply the deficiency for the fiscal year 1865–'66, in

parallel columns, with the estimates which were originally submitted for the whole fiscal year, and which, though approved by both houses of Congress at the last session, failed to become a law before the expiration of that session.

Object.	Estimate for fiscal year 1865–'66, but not appropriated.	Estimate for deficiency.
For survey of the Atlantic and Gulf coasts of the United States, including compensation of civilians engaged in the work, per act of March 3, 1843	$181,000	$120,000
For continuing the survey of the western coast of the United States, including conpensation of civilians engaged in the work, per act of September 30, 1850	100,000	75,000
For continuing the survey of the reefs, shoals, keys, and coast of south Florida, including compensation of civilians engaged in the work, per act of March 3, 1849	11,000	11,000
For publishing the observations made in the progress of the survey of the coast of the United States, including compensation of civilians engaged in the work, per act of March 3, 1843	4,000	4,000
For repairs of steamers and sailing schooners used in the survey, per act of March 2, 1853	20,000	20,000
For pay and rations of engineers for three steamers used in the hydrography of the coast survey, no longer supplied by the Navy Department	6,000	6,000
Total	322,000	236,000

The estimates presented for the fiscal year 1866–'67 approach more nearly to the scale of expenditure before the war. They contemplate the continuance of work in the southern sections, which, besides being called for to aid in the development of the resources of that part of our country, will be conducive to economy, since it will, as formerly, enable the same parties to push the work on the southern coast during winter, after closing work for the season at the north. Without any material increase in the salaries and office expenses, the amount of field-work accomplished will be far more than proportionably augmented.

Owing to the great increase in the price of labor and supplies of every kind, the appropriations asked for, although the same in amount of the two principal items as those for 1860–'61, will not be equivalent to the latter, yet they are as low as is consistent with an economical prosecution of the work in the several localities where it has been commenced.

The item providing for the continuation of the survey of the Florida reefs and keys has been diminished from forty to twenty-five thousand dollars, because that important work is proportionally far advanced towards completion. The item providing for repairs of vessels, on the contrary, is unavoidably increased by reason of the great increase in the cost of such repairs, and because a larger amount of refitting is at present necessary, on account of the greater wear and tear during the war.

The estimates for progress on the Atlantic, Gulf coast, Florida reefs, and western coast of the United States are given, as usual, in separate items, and are preceded by a detailed statement of the progress contemplated in the several sections of the work.

Estimates in detail for the fiscal year 1866–'67.

For general expenses of all the sections, namely: rent, fuel, materials for drawing, engraving and printing, and for transportation of instruments, maps, and charts; for miscellaneous office expenses, and for the purchase of new instruments, books, maps, and charts $21,000

SECTION I. *Coast of Maine, New Hampshire, Massachusetts, and Rhode Island.* FIELD-WORK.—To continue the triangulation of *Passamaquoddy bay,* and extend it so as to include the northeastern boundary along the *St. Croix river;* to complete the secondary triangulation of the coast of Maine, west of *Mount Desert island;* to continue the topography of *Passamaquoddy bay* and its dependencies; to continue that of *Gouldsborough bay,* that of the islands at the entrance of *Penobscot bay,* and the western shore of the bay above *Camden;* that of the adjacent shores of *Muscongus sound* and *Medomak river;* to complete the topography of the *Damariscotta river,* and the survey of the eastern shores of *Casco bay;* to continue that of the coast of *New Hampshire,* between *Great Boar's Head* and *Portsmouth,* and to complete that

of the shores of *Massachusetts bay* between *Sandwich* and *Plymouth;* to continue the detailed survey of the shores and islands of *Narragansett bay;* to continue off-shore soundings along the coast of Maine, and the hydrography of *Passamaquoddy bay, Frenchman's bay, Gouldsborough bay, Prospect and Winter harbors,* and the approaches to *Penobscot bay;* to continue tidal and magnetic observations at Portland, and tidal observations in the progress of the hydrography. OFFICE-WORK.—To make the computations required for, and reductions from, the field observations; to continue the drawing of coast chart No. 1, *Passamaquoddy bay;* to continue the drawing and engraving of coast chart No. 6, approaches of *Penobscot bay;* of No. 7, *Pemaquid Point* to *Cape Elizabeth;* of No. 8, approaches to *Casco bay;* of No. 10, coast of Massachusetts from *Cape Ann* to *Plymouth;* of No. 11, *Cape Cod bay,* and of No. 14, *Narragansett bay and approaches;* to continue the drawing and engraving of general coast chart No. 1, *Quoddy Head, Me., to Cape Cod, Mass.;* to complete the drawing and engraving of charts of *Rockland, Camden, and Rockport harbors;* to continue the drawing and engraving of *Eastport harbor, Winter harbor, Tennant's harbor* and *Herring gut,* of *St. George's river,* and *Muscle Ridge channel,* and of the *Damariscotta river;* and to complete the drawing and engraving of charts of the *Sheepscot river, Me.,* of *Newport harbor,* and of *Providence river, R. I.,* and to engrave the resurvey of *Boston harbor,* will require........................ $43,000

SECTION II. *Coast of Connecticut, New York, New Jersey, Pennsylvania, and part of Delaware.* FIELD-WORK.—To make supplementary astronomical observations to continue the triangulation of *Connecticut river,* between Higganam and Hartford, and that of the *Thames river* above *New London;* to continue verification work on the *coast of New Jersey,* south of Absecom inlet; to continue the topography of the shores of the *Connecticut;* to execute such supplementary hydrography as may be required in *New York bay and Delaware bay;* to continue the tidal observations. OFFICE-WORK.—To make the computations and reductions; to complete the engraving of coast chart No. 21, *New York harbor* and its approaches, (new edition,) and to commence the drawing and engraving of coast chart No. 22, from *Sandy Hook to Barnegat;* and to complete the engraving of coast chart No. 28, from *Cape May, N. J.,* to *Isle of Wight, Del.,* will require.. 15,000

SECTION III. *Coast of part of Delaware and that of Maryland and part of Virginia.* FIELD-WORK.—To continue astronomical and magnetic observations in the section, and secure the stations of the triangulation; to make extensions of the triangulation for including the detached plane-table surveys in the vicinity of *Washington city;* to complete the topography near *Washington,* required for defensive purposes, and continue that of the eastern shore of Virginia; to make such detailed surveys as may be necessary at points on the *Potomac, Rappahannock, and James rivers;* and to continue the off-shore hydrography and tidal observations in the section. OFFICE-WORK.—To make the computations from field-work; to continue the engraving of coast chart No. 29, (from *Isle of Wight, Del., to Chincoteague, Va.,*) and of No. 30, (from *Chincoteague to Great Machipongo inlet, Va.;*) to continue the engraving of coast chart No. 30 *bis,* (*Chesapeake entrance,*) and general coast chart No. IV, (approaches to Delaware and Chesapeake bays;) and to commence the drawing and engraving of a chart of *James river* from *Newport News* to *City Point,* will require 20,000

SECTION IV. *Coast of part of Virginia and part of North Carolina.* FIELD-WORK.—To complete, if practicable, the primary triangulation of *Pamlico sound,* and make the requisite astronomical and magnetic observations; to continue the triangulation of *Pamlico river;* to continue the triangulation and topography of the shores of *Neuse river;* to complete the topography of the outer coast of *North Carolina,* between *Hatteras inlet* and *Core sound;* to continue the in-shore and off-shore hydrography in the vicinity of *Cape Lookout;* and to execute that of *Pamlico river,* and such other soundings as may be required in the waters of *Pamlico* and *Albemarle sounds;* to make observations of the tides and currents. OFFICE WORK.—To make the computations and reductions; to continue the drawing and commence the engraving of general coast chart No. V, from Cape Henry to Cape Lookout; to continue the engraving of coast chart No. 38, (from Currituck, Va., to New inlet, N. C.,) and of coast charts Nos. 46 and 47, (from Cape Lookout to Barren inlet,) and the drawing and engraving of charts

of *Pamlico sound,* and of the *Neuse and Pamlico rivers;* and to complete the engraving of coast chart No. 48, Cape Fear and approaches, will require $30,000

SECTION V. *Coast of part of North Carolina and that of South Carolina and Georgia.* FIELD-WORK.—To continue the secondary triangulation of the coast of *Georgia;* to continue the topography of *Port Royal sound,* and of the islands and interior passages between it and *St. Helena sound;* to continue that of the shores of *Wassaw sound* and *Ossabaw sound* and of the rivers connecting them, and to join with the work on the passages from *Savannah river;* to complete the re-survey of *Charleston bar* and of the entrance to *Savannah river;* to complete the hydrography of *Wassaw sound* and its dependencies, connecting with *Tybee entrance* and *Savannah river,* and if practicable, to begin that of *St. Andrew's sound;* to connect the hydrography of *Doboy entrance* with the in-shore work between *Capelo and St. Simon's;* to continue the tidal observations at *Hilton Head* and *St. Mary's river entrance.* OFFICE-WORK.—To continue the engraving of coast chart No. 53, (from Rattlesnake shoal to St. Helena sound, S. C.;) to continue the drawing and engraving of No. 54, (from Fripp's inlet, S. C., to Ossabaw sound, Ga.;) to continue the drawing of No. 57, (from Sapelo sound to St. Andrew's sound, Ga.,) and that of general coast chart No. VII, (from Winyah bay, S. C., to St. John's river, Fla.,) and continue the engraving of the last-named chart; the resurvey of *Charleston harbor entrance,* and the drawing and engraving of the inland passages between St. Helena and Port Royal sounds, S. C., and of Wassaw sound, and the inland tide-water communications on the coast of Georgia, will require 32,600

SECTION VI. *Coast, keys, and reefs of Florida.*—(See estimates of appropriation for these special objects.)

SECTION VII. *Part of the western coast of the Florida peninsula and part of the northern coast of Florida.* FIELD-WORK.—To continue the triangulation from the *Auclote keys* towards *Tampa bay,* and from *Cape St. Blas* towards *St. Andrew's bay;* to complete the triangulation across the neck of the peninsula from *Fernandina* to *Cedar keys;* to make such astronomical and magnetic observations as may be practicable in the section; to continue the coast topography from *Bayport* southward, and that of the shore of *St. Vincent's sound* westward towards *Cape San Blas;* to re-examine the hydrography of the entrance to *Appalachicola* and *St. Mark's;* to complete the hydrography of St. George's sound, and continue that south of *Cedar keys;* to make the requisite tidal observations. OFFICE-WORK.—To deduce results by computations; to continue the drawing and engraving of coast chart No. 81, coast of Florida, from *Chassahowitzka river* to *Cedar keys;* to complete the drawing of No. 85, *St. George's sound,* (eastern part;) to continue the drawing and commence the engraving of off-shore chart No. XIII, coast of Florida, from *Waccasassa river* to *Choctawhatchee river,* and that of coast chart No. 84, Florida coast, from *Ocilla river* to *Crooked river,* (St. George's sound,) will require 30,000

SECTION VIII. *Coast of Alabama, Mississippi, and part of Louisiana.* FIELD-WORK.—To continue the astronomical (including longitude) and magnetic observations required in the section; to complete the triangulation and topography of the *Mississippi delta,* and extend the survey up the river towards *New Orleans;* to commence the triangulation at *Point au Fer,* and extend it towards *Ship shoal* and *Isle Derniére,* and to keep up the topography; to continue the hydrography of *Chandeleur* and *Isle au Breton sounds;* to complete that of the *Mississippi Passes* and of *Lake Pontchartrain,* and to make the tidal and current observations required. OFFICE-WORK.—To continue computations; to continue the drawing and engraving of off-shore chart No. XIV, Gulf coast, from *Choctawhatchee river to the Mississippi delta;* to continue the drawing and engraving of the chart of *Lakes Borgne* and *Pontchartrain,* (coast chart No. 93,) and to commence that of the *Mississippi delta,* (coast chart No. 96,) will require 32,000

SECTION IX. *Part of the coast of Louisiana and coast of Texas.* FIELD-WORK.—To make the requisite astronomical and magnetic observations, and to measure, if practicable, a primary base line and one of verification; to continue the triangulation of *Madre lagoon* and *Padre island* southward towards the boundary; to continue the topography of *Nueces* and *Corpus Christi bays,* and that of the coast southward; to complete the hydrography of *Matagorda bay* and its dependencies; to make the tidal observations required. OFFICE-WORK.—To make computations; to complete the drawing and continue the engraving of coast map and chart No. 108, *Mata-*

gorda and *Lavaca bays;* to complete the topographical drawing of No. 109, Gulf coast from *Matagorda* to *Aransas Pass,* and the engraving of Nos. 106, 107, and 108, between *Galveston and Matagorda entrances,* and to continue the drawing of off-shore chart No. XVI, Gulf coast, from *Galveston to the Rio Grande,* will require	$27, 000
Total for Atlantic coast and Gulf of Mexico	250, 000

The estimates for the Florida coast, keys, and reefs, and for the western coast of the United States, are intended to provide for the following progress:

SECTION VI. *Coast, keys, and reefs of Florida.* FIELD-WORK.—To continue the triangulation of *Indian river* and adjacent coast northward; to make such astronomical and magnetic observations as may be requisite and practicable in the section; to complete the triangulation of *Sarasota sound,* and to commence that of *Tampa bay;* to follow the triangulation of *Indian river* and the coast adjacent with the topography; to complete the topography of the southern keys; to follow the triangulation of *Sarasota sound* by the topography; to continue the hydrography between the *Dry Tortugas* and *Key West,* and to run off-shore lines from the reefs and coast of this section; to continue the hydrography of *Charlotte harbor* and its approaches; and to keep up the magnetic observations at *Key West.* OFFICE-WORK.—To compute results from field records; to continue the drawing and commence engraving of off-shore chart No. XI, western part of Florida reefs, including the *Tortugas;* to complete the engraving of chart No. 70, *Florida reefs,* between *Long key* and *Newfound Harbor key;* to complete the engraving of the chart of *Charlotte harbor entrance,* and commence that of *San Carlos bay;* to commence the drawing of coast map and chart No. 64, *Florida coast,* between *Jupiter inlet* and *Indian River inlet,* will require	$25, 000
SECTION X. *Coast of California.* FIELD-WORK.—To continue the coast triangulation southward of the *San Pedro base,* or northward of *Santa Barbara,* and the work for connecting the *Santa Barbara* islands by triangulation with the coast of California; to continue the triangulation northward from *Bodega,* and to execute that of *Suisun bay;* to continue the topography of the islands in *Santa Barbara channel,* that of the shore of *Bahia Ona,* that of the coast north of *Bodega Head,* and to complete that of *Suisun bay;* to complete the hydrography of *Suisun bay;* to run off-shore lines of soundings from the principal headlands of the section; to extend the in-shore hydrography northward of *Bodega,* and re-examine bars subject to change in *San Pablo bay;* to continue tidal observations at *San Diego* and *San Francisco.* OFFICE-WORK.—To make the computations from field-work; to complete the drawing and engraving of a chart of *Halfmoon bay;* the engraving of the resurvey of *Mare Island straits,* and of the upper sheet of *San Francisco bay,* and of a chart of *Suisun bay;* to continue the drawing and engraving of a general coast chart of the Pacific, (from San Diego to Point Conception,) of a chart of *San Francisco bay,* to be issued in one sheet, and of a chart of the coast from *Point Pinos* to *Bodega Head.*	
Also, for the operations in—	
SECTION XI. *Coast of Oregon and that of Washington Territory.* FIELD-WORK.—To make the astronomical and magnetic observations required in this section or in Section X; to continue the triangulation of *Washington sound* in connection with former work, and to make such plane-table surveys in continuation of previous work as may be practicable; to continue the hydrography in *Admiralty inlet;* to execute soundings in special localities of Oregon or Washington Territory, as may be called for by public interests; to continue tidal observations at *Astoria,* and make such as may be required by hydrography. OFFICE-WORK.—To continue the computations of field-work; to continue the drawing and engraving of surveys, as far as now made, for charts of *Koos bay, Gray's harbor, Washington sound, Admiralty inlet,* and *Puget sound,* will require	130, 000
For publishing the observations made in the progress of the survey of the coast of the United States, per act of March 3, 1843	5, 000

For repairs of steamers and sailing schooners used in the survey, per act of March 2, 1853.... $20,000
For pay and rations of engineers for the steamers used in the hydrography of the coast survey, and no longer supplied by the Navy Department........ 10,000

The subjoined table exhibits in parallel columns the appropriations made before the war, those during the war, and the estimates now submitted for the fiscal year 1866–'67:

Object.	Appropriated 1860–'61.	Appropriated 1864–'65.	Estimates for 1866–'67.
For survey of the Atlantic and Gulf coasts of the United States, including compensation of civilians engaged in the work, per act of March 3, 1843	$250,000	$178,000	$250,000
For continuing the survey of the western coast of the United States, including compensation of civilians engaged in the work, per act of September 30, 1850	130,000	100,000	130,000
For continuing the survey of the reefs, shoals, keys, and coast of south Florida, including compensation of civilians engaged in the work, per act of March 3, 1849	40,000	11,000	25,000
For completing the line to connect the triangulation on the Atlantic coast with that on the gulf of Mexico, across the Florida peninsula, including compensation of civilians engaged in the work, per act of March 3, 1843	5,000	....	....
For publishing the observations made in the progress of the survey of the coast of the United States, including compensation of civilians engaged in the work, per act of March 3, 1843........	5,000	4,000	5,000
For repairs of steamers and sailing schooners used in the survey, per act of March 2, 1853........	10,000	4,000	20,000
For fuel and quarters, and for mileage or transportation, for officers and enlisted soldiers of the army serving in the coast survey, in cases no longer provided for by the quartermaster's department, per act of August 31, 1852	5,000	....	....
For pay and rations of engineers for steamers used in the hydrography of the coast survey, no longer supplied by the Navy Department........	12,800	9,000	10,000
Total	457,800	306,000	440,000

SPECIAL SURVEYS.

In the winter of 1864–'65, application was made by the government of Nicaragua, through the Department of State, for the temporary service of a corps of our skilled surveyors for a special survey of the San Juan river, and of the harbor of San Juan del Norte or Greytown. This request, made known by the Hon. Don Luis Molina, and through the Treasury Department referred to the Superintendent, was met in January by the designation of Assistant P. C. F. West for the charge of the service desired. With him were associated Mr. A. Strausz, as hydrographic assistant, Sub-Assistant Charles Hosmer, and Mr. R. E. McMath as topographers, and Messrs. H. G. Ogden and H. L. Marindin as aids. The expenditures for the work, including the compensation of the officers, were defrayed by the applicants in conformity with terms made when the party was organized.

Besides the special duty called for at the outset, surveys or examinations were made of the Colorado river, the Caño Bravo, the San Juanillo river, and of the harbors of Monkey Point, Virgin Bay, and San Juan del Sur.

The party returned to the north in July, and resumed regular duty in the northern sections of the Atlantic coast.

HYDROGRAPHIC DEVELOPMENTS.

In Appendix No. 4 will be found a description of Cape Lookout shoals, with reference to the chart (Sketch No. 12;) and Appendix No. 5 gives an interesting account of the changes that have taken place in the entrances to Cape Fear river, resulting from a comparison of its new survey (Sketch No. 13) with the former chart.

The changes in the channels over Charleston bar, resulting from the obstructions placed in the main

channel by the blockading squadron are very marked, and can be readily seen by comparing the new chart (Sketch No. 14) with the former one. The "*stone-fleet*" has entirely disappeared; but where it was placed the water has shoaled from four to six feet, while on either side of it a new channel has formed, of the same depth as the former one. This increased water-way for the ebb-stream in a direct line from the deep water of the harbor appears to have permitted the filling up of the southern *swash* or Lawford channel, at a point four miles distant from where the obstructions were placed.

TIDES.

Appendix No. 11 gives an explanation, in a new form, of the law of the tides on the western coast, illustrated by a diagram, (Sketch No. 26.) As the sequence of these phenomena is somewhat complicated, it was thought desirable to illustrate them in this manner.

The general table of tidal constants, for predicting the tides at any time at the various ports in the United States, which has appeared for several years in the annual report of the Coast Survey, is not reprinted this year. Tide tables, giving the time and height of high water on every day in the year, for all ports in the United States, are in preparation, and will be published annually hereafter.

LIST OF ORIGINAL MAPS AND CHARTS IN THE OFFICE.

A table of all original topographical maps and hydrographical charts made in the progress of the survey, and on file in the Coast Survey office, is given in Appendix No. 8. These lists will be found highly useful for reference, and will greatly facilitate calls for local information. They are arranged in geographical order, each class separately, and give the title, reference, number, and scales, as well as the name of the person by whom the survey was made.

These originals are kept in a fire-proof building, each sheet rolled up in a separate tin-tube, numbered to correspond. As no duplicates of these maps exist, it seems highly desirable that such should be provided for, and I make the suggestion that the several States should procure copies of such of them as fall within their respective boundaries, to be kept among their own archives. A small annual expenditure on the part of each seaboard State would, in a few years, suffice to cover the cost of making copies of these valuable documents.

GEOGRAPHICAL POSITIONS.

A table of geographical positions of stations, determined in the progress of the triangulation, is given in Appendix No. 9, in continuation of similar tables heretofore published in the Coast Survey reports. The table gives the latitude and longitude of each station, its distance from two other stations, and the azimuth or true bearing of the lines joining them. These positions, which form the framework of the Coast Survey charts, will be found of great convenience in joining local surveys to the great scheme of the Coast Survey, by affording bases of known length and direction. The localities of the station can be approximately seen on the progress sketches of triangulation accompanying this and other reports; their exact positions are generally well known in the neighborhood, and the specific descriptions of the marks by which each station may be identified, can always be obtained by application to the Coast Survey office.

In addition to the foregoing list of positions which have been determined trigonometrically, Appendix No. 10 gives the latitudes and longitudes of a number of places in West Virginia, and on the Mississippi, Ohio, and Tennessee rivers, which have been determined astronomically by Coast Survey parties operating in connection with the military and naval forces, as heretofore reported.

LONGITUDES.

The investigation of the subject of determination of longitude from the occultation of the Pleiades by the moon has been continued by Professor Benjamin Peirce, LL.D., of Harvard University. In Appendix No. 12 his report of progress is given, and in Appendix No. 13 the exposition of the method employed is further continued from former reports.

The reduction of the observations heretofore made for the longitudes of places in the United States by means of the electric telegraph has been continued by Dr. B. A. Gould, whose report of progress is given in Appendix No. 14, where he likewise communicates a synopsis of the observations made by him with the transit instrument of the Coast Survey, loaned to him for use in his private observatory. In the course of the work under his charge, occasion has been taken to collect and discuss the observations of the declinations

of the same standard stars, the right ascensions of which have been heretofore published; the results are given in Appendix No. 15. In the next following paper, Dr. Gould gives the corrections of some errors that had slipped into the list of circumpolar stars heretofore published, and in Appendix No. 17 he gives the results of observations of latitude made at the Cloverden station in Cambridge, the close accordance of which establishes that point as one of the best known in latitude.

MAGNETISM.

An interesting discussion of the results of magnetical observations made monthly during a series of years at Eastport, Maine, will be found in Appendix No. 18. The object of these observations was to ascertain the amount of annual and secular variations of the magnetic elements at that easternmost station of our domain. It will be seen that those results have been reached by a system of observations which does not involve a sacrifice of time and labor too great to be encountered singlehanded by persons disposed to devote some spare hours to the investigation of this important subject. It is greatly to be desired that similar observations should be made at various points throughout the country. The convenient form of magnetometer employed, which was designed by Assistant J. E. Hilgard, and constructed by Mr. W. Würdemann, is figured in Sketch No. 29.

In connection with this subject there is given a chart of the *magnetic declination* in the United States for the year 1870, (Sketch No. 27,) and a diagram showing the secular variation of the declination (Sketch No. 28) as far as ascertained. Appendix No. 19 explains the mode of construction of these charts.

TABLE OF PROJECTIONS FOR A MAP OF NORTH AMERICA.

The system of projecting maps used in the Coast Survey, being a polyconic development of the earth's surface, now generally known as the *Coast Survey projection*, is adapted to represent large areas with the least possible distortion, and is, therefore, getting into very general use for maps of all kinds. To meet the demand for data for its construction, tables have been heretofore published in the Coast Survey reports for 1853, 1856, and 1859, which cover the whole extent of the territory of the United States. In order to facilitate the construction of maps embracing the whole of North America, a similar table is given in Appendix No. 20, giving the required co-ordinates for the insertions of the meridians and parallels for every five degrees, from the equator to the pole.

Added to this table is a continuation of the table in the Coast Survey report for 1859, which gives the co-ordinates of curvature for projections for every degree of longitude to 30°, the former table extending from the equator to latitude 54°, while the present one continues the same to the poles.

GEODESY.

The primary triangulation of the coast of New England, from the vicinity of the Hudson to the St. Croix river, has been completed by the occupation of stations West Hill and Roland during the past summer. It has been executed between the years 1844 and 1865 by the party of the Superintendent, and the observations have been made in great part by himself. Near each extremity of this great chain of triangles, (see Sketch No. 1,) extending over six hundred miles, a base line has been measured—one on Fire Island beach, in the early days of the survey in 1834, by the first Superintendent, Prof. F. R. Hassler; and the other on Epping plains, in Maine, with different bars and apparatus, by the present Superintendent, Prof. A. D. Bache, in 1857. There is, besides, an intermediate base line in Massachusetts, on the line of the Boston and Providence railroad, measured in 1844 by Assistant Edmund Blunt. In Appendix No. 21 of this report will be found a discussion of these different measurements, and of the triangulation joining them, together with a comparison of results and an estimate of the ultimate accuracy attained. From this discussion we learn that the agreement of the base lines, when reduced to each other by means of the triangulation, is closer than the estimate of the unavoidable errors of observation would lead us to expect, and that consequently the estimate of accuracy derived from the agreement of the observations among themselves is fully justified.

The probable error of any assigned distance is thus found to be about equal to its three hundred thousandth part, or less than a quarter of an inch in a mile. The disagreement of the two extreme base lines, distant from each other 430 miles, is only one and two-thirds inches in the length of the Epping base.

The methods of computation are fully illustrated in the paper referred to, which closes with a final adjustment of the triangulation, such that the measured value of the base lines are preserved, and a side com-

mon to the three branches of the triangulation has the same length assigned to it from whichever base line it is derived.

The discussions and computations have been made by Assistant C. A. Schott, in consultation with and under the immediate direction of Assistant J. E. Hilgard, in charge of the office.

TOPOGRAPHY.

The *plane-table* is used in the Coast Survey as the principal instrument for mapping the topographical features of the country, and is universally recognized as the most efficient and accurate means for that purpose. Its application under various conditions, the methods of its use and styles of topographical representation, have received a great development in the practice of the topographers of the Coast Survey, and special acknowledgment is due in this respect to the comprehensive views, practical tact, and elegant taste of Assistant H. L. Whiting, whose efforts have established the high standard of topographical maps recognized in the Coast Survey.

In order to meet the frequently expressed want of a treatise on the plane-table and its use, which does not appear to be supplied by any existing book in our language, an essay on this subject has been prepared for this report by Assistant A. M. Harrison, during an interval of enforced leisure, while prevented by impaired health from more active labor in the field. Mr. Harrison acknowledges his indebtedness to many of his colleagues for contributions and aid in the preparation of this work. It forms Appendix No. 22 of this report, and is illustrated by a representation of the plane-table, on Sketch No. 30, and by a map, Sketch No. 32, which is designed as an example of a plane-table sheet, on a scale of $\frac{1}{10000}$, drawn in a style suited to the large scale of representation. As it was intended to unite on this map all the leading characteristics of country and topographical signs, it is of necessity a composition, but all its separate features are from actual surveys.

CATALOGUE OF CHARTS.

A catalogue of the charts published by the Coast Survey office was given in the report for 1864; it is also printed separately, and can be had on application to the office. The prices vary from twenty cents to one dollar per sheet, according to the size and character of the chart. A discount of thirty-three per cent. is made to agents. The sale of charts has largely increased within late years, evincing a growing appreciation of their usefulness.

The maps and charts embraced in the catalogue are of two general descriptions, which may be distinguished as *preliminary* and *finished*. The preliminary charts are those which are issued as soon after the several surveys as is consistent with accuracy of general delineation, and are designed to supply the immediate and pressing demands of navigation. The finished charts embody *all* the information furnished by the survey, including the minutest details, and embrace not only the hydrography, but the topography likewise. The two classes of charts differ in regard to the *amount* of the information which they furnish, but not in regard to the correctness of that which is given.

The charts are various in character, according to the objects which they are designed to subserve. The most important distinctions are the following:

1. *Sailing Charts*, upon a scale of $\frac{1}{1200000}$, embracing the largest area of any, and designed to enable the navigator to protract his course. Four of these cover the entire Atlantic coast of the United States, and a fifth embraces the entire coast of the Gulf of Mexico.

2. *General Charts of the Coast*, on a scale of $\frac{1}{400000}$, for off-shore navigation. These represent the shore-line and its characteristic features, so as to be readily recognized by the navigator approaching it. The entire Atlantic and Gulf coasts will be comprehended in sixteen charts of this class.

3. *Preliminary Sea-coast Charts*, on a scale of $\frac{1}{200000}$, for in-shore navigation. These will all be ultimately superseded by the more complete charts next to be named.

4. *Coast Charts* for in-shore navigation, on a scale of $\frac{1}{80000}$, exhibiting with minute accuracy every natural and every permanent artificial feature, above or below the water, which can be introduced without occasioning confusion. They exhibit, also, the topography for some distance from the shore.

Besides the foregoing, there are numerous charts of harbors, bays, anchorages, &c., and sketches of local dangers, on various scales.

PART II.

SECTION I.

FROM PASSAMAQUODDY BAY TO POINT JUDITH, INCLUDING THE COAST OF THE STATES OF MAINE, NEW HAMPSHIRE, MASSACHUSETTS, AND RHODE ISLAND. (SKETCHES NOS. 1 AND 2.)

Notices of work in this and in the other sections of the Atlantic coast, gulf of Mexico, and Pacific coast of the United States will be made in geographical order. Either in triangulation, topography, or hydrography, the survey has been advanced in Passamaquoddy bay, in Gouldsborough bay, and Prospect harbor, in Frenchman's bay, Penobscot bay, on the St. George and Medomak rivers, in Muscongus bay, including its islands; the shores of the Damariscotta, the Sheepscot and Kennebec rivers, Quohog bay, Casco bay, Nantucket harbor, the Sow and Pigs reef at the entrance of Buzzard's bay, the shores of Narraganset bay, and Seekonk river.

Tidal and magnetic observations have been continued at Portland, and tidal observations at the Charlestown navy-yard, in this section.

A synopsis, showing the distribution of field parties and the localities in which they have been at work in the course of the season, is given in Appendix No. 1.

Shore-line survey of Passamaquoddy bay, Maine.—Plane-table work in the vicinity of the northeastern boundary has been continued by the party of Sub-Assistant W. H. Dennis, with the schooner Caswell. After re-establishing the triangulation points, of which but two were found standing, the shore-line survey was continued on Sheet No. 4, showing the approaches to Letite Passage. (See Sketch No. 2.) This is one of the entrances to the St. Croix river. "The work on this sheet was attended with difficulties, owing to the great rise and fall of the tides, and the consequent rapid currents, the rate of which through the passage is from six to eight knots per hour. In easterly and southerly winds, the vessel, moreover, was exposed to a heavy sea. On this sheet a number of ledges are marked, though they show only at low water. The shore-line itself could be defined only at that stage of the tide. Sheet No. 5, the shore-line of which is also completed, connects with No. 1 and No. 4, and extends the shore-line survey about five miles to the northward, or almost to the mouth of the St. Croix. Sheet No. 6, of which the shore-line will be traced before the close of the present season, embraces the mouth of the St. Croix river and all the water line of that vicinity to a point about a mile northward of St. Andrews."

The present season is mentioned in the field report as having been remarkably favorable for topographical work. A summary of the statistics is appended:

Shore-line surveyed	47 miles
Contour of ledges	16 "

During the summer and preceding winter, the party in the Caswell were on field duty in Section V, and under that head notice will be made of their previous work.

Topography of Gouldsborough bay and Prospect harbor, Maine.—The plane-table survey to the eastward of Mount Desert island (see Sketch No. 2) was resumed by Sub-Assistant Cleveland Rockwell at the end of June. Taking up the survey at Schoodic Point, the plane-table work was extended to Indian harbor, lying at the mouth of Gouldsborough bay, by the close of August. "The character of the topography on this sheet is the most rugged and difficult of rocky coast line. Bunker's, Birch, Prospect, and Indian harbors are embraced within its limits."

"The second sheet worked on this season embraces Gouldsborough, Steuben, and West bays, and a group

of small islands lying across the main entrance to them from the ocean. These islands make an excellent ship harbor of the bay, which is a mile wide, of moderate depth, and entirely free from ledges or shoals, so far as known at present. The anchorage for ships is good in any part of the bay. In Steuben and West bays there is a large area of mud-flats and ledges."

The following is a summary of the plane-table statistics:

Shore-line	79 miles.
Roads	21 "
Area of topography (square miles)	23 "

The schooner Bailey was used by the party for transportation. Field-work was closed for the season on the first of October. Mr. Rockwell, during the early part of the year, was on duty in Section IV. He is now about to resume field duty in Section III.

Triangulation of Frenchman's bay, Maine.—The secondary triangulation of the coast of Maine has been extended through the passage north of Mount Desert island and eastward over the upper part of Frenchman's bay, by the party of Assistant G. A. Fairfield. This work (see Sketch No. 2) includes also the triangulation of Skillings river, and completes that required for the survey of islands that lie in the passage between Mount Desert island and the mainland. Field-work was commenced on the fifth of July and closed at the end of September. The triangles laid out and measured connect with stations in the previous work done by Sub-Assistant Webber, and the secondary work, as heretofore, has been kept in close connection with the primary triangulation. The positions of the outer islands abreast of Isle au Haut bay are yet to be determined, in order to complete the secondary triangulation of this part of the coast.

Assistant Fairfield was aided by Mr. F. D. Granger. The party used the schooner Dana for transportation. The original note-books and computations have been duplicated and deposited in the office. A synopsis from these records is here given:

Signals erected	14
Stations occupied	16
Angles measured	130
Number of observations	2,048

The angles were measured with the ten-inch theodolite, No. 91.

Hydrography of Penobscot bay.—This work has been continued in the vicinity of Rockport and Camden by a party in charge of Mr. Horace Anderson. The party was at the working ground on the 1st of September. After erecting the signals and determining the points needed, a tide gauge was set up at the lower steamboat wharf in Camden. The soundings were resumed in Rockport harbor (see Sketch No. 2) and were extended so as to connect with those made in 1863 by Assistant Edwards. In pushing the work northward towards Camden, the lines of soundings were carried in a southeasterly direction far enough to include "Graves' Rock," which lies between the two harbors. This rock and the ledges off Camden harbor are the only dangers yet developed by the hydrography of the vicinity.

The ledges off Camden were examined separately. These are entirely covered at high tide. For the hydrographic work Mr. Anderson put up sixteen signals and determined twenty-two objects in position by occupying thirty stations. He was efficiently aided by Messrs. L. A. Sengteller and McL. W. Thomson. The statistics of the work are as follows:

Miles run in sounding	202
Sextant angles measured	2,525
Number of soundings	9,669

The hydrography was continued until the 10th of November.

Topography of St. George's river, Maine.—The supplementary details filled in during June and July by the party of Sub-Assistant Charles Ferguson complete the plane-table survey of the shores of the St. George. The work of this season was confined mainly to the lower part of the river and to the islands at the entrance, of which the shore lines had been previously traced. To the eastward this survey connects with that of Penobscot bay, and to the westward with work done by the same party on the Medomak river. The statistics are as follows:

Shore line traced	12 miles.
Roads	$10\frac{1}{2}$ "
Area of topography, (square miles)	4

Topography of Medomak river, Maine.—This work was taken up on the 1st of August by Sub-Assistant Ferguson, at Waldoboro, the head of navigation. By the end of September the survey was extended southward (see Sketch No. 2) to include a considerable part of Long island and the shore line of both sides of the Medomak for a distance of six miles. The detailed survey was pushed several miles below the village, on the east side, as far as Sampson's cove, and on the western shore to the vicinity of Stahl station. A summary of the statistics is appended:

Shore-line surveyed	44 miles.
Roads	16 "
Area of topography, (square miles)	2½

Topography of islands in Muscongus bay, Maine.—The party of Sub-Assistant F. W. Dorr met at Boothbay (see Sketch No. 2) on the first of July, and started work on a plane-table sheet to include the survey of the islands lying in that vicinity and others lying off the mouth of the Damariscotta river. The main shore was also traced on that sheet from Mount Pisgah and Spruce Point to the west side of the Damariscotta, including Lineken's neck and bay, the village of Hodgdon's Mills, and Rutherford's island. In this vicinity the details join with the work of the season done by Assistant Gilbert. On the completion of this sheet the survey of the islands lying in Muscongus bay was taken up and completed, the party being so occupied until near the end of September. Moving then to the mouth of the river St. George, all the islands off that river which had not been previously included were surveyed with the plane-table. The work of this party was done with a boat belonging to the surveying schooner Hassler. It is embraced on three topographical sheets, all of which have been inked and are now on file at the office. A synopsis of the statistics is appended:

Shore-line traced	125 miles.
Roads	18 "
Area of topography, (square miles)	31

Mr. Franklin Platt served as aid in the plane-table party, and his interest in the progress of the work and aptitude for field duty are warmly commended in the report of Sub-Assistant Dorr.

Under the head of Section IV mention will be made of the previous occupation of Mr. Dorr.

Hydrography of Muscongus bay.—A party in charge of Sub-Assistant R. E. Halter, with the schooner James Hall, resumed this work on the first of August, and continued soundings until the first of September, when, in consequence of the illness of Mr. Halter, the party was placed in charge of Sub-Assistant Clarence Fendall. The progress made completes the hydrography of the approaches to St. George's river (Sketch No. 2) from points as far south as Allen island and Burnt island, and beyond them connects with the general hydrography of the coast of Maine. In-shore soundings are now continuous from Penobscot entrance to the southward as far as the approaches to Chesapeake bay.

Sub-Assistant Fendall prosecuted soundings until the middle of October, and soon after turned in the chart of work. The hydrographic statistics are as follows:

Miles run in sounding	134
Angles measured	2,000
Number of soundings	4,759

The soundings made were referred for adjustment to the tidal station temporarily occupied for that purpose in Herring Gut harbor.

The hydrographic party was efficiently aided by Mr. J. W. Brown.

Topography of the Damariscotta river, Maine.—This work is embraced by two plane-table sheets, one taking in eight miles of the course of the river above Low's cove, or to a point a mile above the bridge which connects the villages of New Castle and Damariscotta. The second sheet (see Sketch No. 1) continues the survey from Low's cove, six miles below, to Hodgdon's Mills.

The party of Assistant S. A. Gilbert reached Damariscotta on the 6th of June, and as soon as practicable took up field-work. Sub-Assistant J. W. Donn joined Mr. Gilbert in the middle of August. Through the entire season the weather proved unusually favorable, as shown by the result in statistics.

"The character of the topography is broken and rocky, with much scattered woods, the irregular outline of which proved difficult of representation. The elevation of the land ranges in great variety of feature from the perpendicular rock face to the almost imperceptible slope of the peat swamps in which the numerous brooks have their sources."

"In the upper part of the river are extensive flats, bare at low water, through which the channel runs in a crooked course for three miles. The outline of these flats was a difficult feature to determine in a satisfactory manner. The shores of the Damariscotta are mostly ragged rocky ledges, worn into many forms by the action of the sea and frost. Numerous ledges, too, lying in the bed of the river, were wholly or in part covered at every tide, and, in consequence, their outline could be obtained only at low water."

The topography was closed on the 13th of October. Of the entire area Assistant Gilbert surveyed twenty-eight square miles. The aggregate statistics of the two sheets are as follows:

Shore-line traced	98 miles.
Roads	78 "
Area surveyed, (square miles)	40

Assistant S. A. Gilbert reported for duty in April, having been since June, 1861, on leave of absence without pay, granted to enable him to accept a commission as lieutenant colonel 24th regiment Ohio volunteer infantry. In October of the same year he was appointed colonel of the 44th regiment Ohio volunteer infantry.

He served from July, 1861, to October, 1862, in the department of West Virginia, and with his regiment was engaged in most of the battles and other arduous service necessitated in that department.

In October, 1862, the regiment was transferred to the department of the Ohio and stationed in Kentucky.

Colonel Gilbert was then assigned to command the second brigade, third division, of the army of central Kentucky.

He retained that command until the organization of the 23d army corps in July, 1863, in which his became the first brigade of the third division.

In Kentucky he was stationed at Richmond, Frankfort, Mount Vernon, and other places, during periods of much local excitement, and by unfaltering energy preserved public order in the surrounding districts. During the raids of Morgan, Pegram, and other rebel commanders, in the spring and summer of 1863, his command participated with credit in hard marches and in frequent skirmishes with the enemy. In the fall, when the army of the Ohio under General Burnside moved into East Tennessee, Colonel Gilbert's brigade was the first of the infantry to reach Knoxville. There he became post commandant. Soon his brigade made a very rapid march to Cumberland Gap to re-inforce the mounted division of General Shackelford. This movement compelled the immediate and unconditional surrender of the rebel garrison, over three thousand strong. The President directed a letter to be addressed to Colonel Gilbert by the War Department, complimenting him and his brigade upon this march and its results.

His command participated in all the operations of the army of the Ohio in East Tennessee until January, 1864, when his own regiment decided to re-enlist as veterans, and was ordered to Cincinnati to be paid and mustered accordingly. The War Department, however, decided that the regiment should be reorganized as cavalry and recruited to the full complement of a mounted regiment, which involved a call for over five hundred additional men. This required time, and the requisite number was not obtained until the early part of April. Colonel Gilbert's health had been frequently interrupted during the previous year, and his condition had not begun to improve. Competent medical advisers informed him that he would not be able to endure the exposure and fatigue of the cavalry service. He, therefore, very reluctantly tendered his resignation, which was accepted in April, 1864.

A year of rest and careful treatment at his home in Ohio restored his health so far that he has been able to resume duty on the survey.

In addition to the evidence contained in official reports there are testimonials of his faithful military services on file in the Adjutant General's office, in letters recommending his promotion to the rank of brigadier general from his division, corps, and army commanders, dating back to November, 1862, and at different times thereafter to January, 1864.

Topography of the Sheepscot river, Maine.—The detailed survey of the vicinity of the Sheepscot river now includes the whole of Westport island, part of Southport island, and the whole of Arrowsic island, the outstanding topography of which was executed this season by Mr. Edwin Hergesheimer. His party was organized in July, and continued work in the field until the 15th of September. Two plane-table sheets embracing this survey are now at the office.

Topography of the Kennebec river, Maine.—This work was resumed early in August by the party of Assistant R. M. Bache, at the limit to which the general survey had been carried last year. From Woolwich the survey was extended several miles to the northward, and as usual was made to include a belt of land about half a mile in breadth. The character of the surface is hilly, rocky, and interspersed with many artificial

details. The plane-table sheet represents also the islands in the Kennebec adjacent to the site of work. A synopsis of statistics is appended:

Shore-line surveyed	$7\frac{1}{2}$ miles.
Roads	$7\frac{1}{2}$ "
Area of topography, (square miles)	$2\frac{1}{2}$

Assistant Bache had been previously engaged in field duty in Section II. The plane-table survey on the Kennebec was continued until the end of October.

Topography of Casco bay, Maine.—The detailed survey of the coast between Portland and Kennebec entrance was completed on the 17th of November by the party of Assistant A. W. Longfellow. The work of the present season, which was taken up on the 7th of June, is comprised (see Sketch No. 2) between Harpswell sound, the shores of which had been previously surveyed by this party, and the mouth of New Meadows river, where it joins the topography executed by Sub-Assistant Iardella. The plane-table sheet of Mr. Longfellow includes the greater part of Orr's island, the peninsula of Sebaskahegan, Yarmouth island, and others in Quohog bay. "The general character of the topography is a series of narrow, wooded ridges, reaching sometimes an elevation of two hundred feet, with rocky, precipitous shores, on which, as the strata stand nearly vertical, it is difficult to find stations for the plane-table."

Assistant Longfellow used the schooner Torrey for the quarters and transportation of his party. In addition to ordinary field duty he retains the charge of vessels of the survey intended to harbor for the winter at Portland, and has supervised their fitting out and delivery to other parties working on the coast of Maine. He also aided Assistant Whiting in inspecting the topographical work of the section.

The statistics of the season's work on the shores of Casco bay are as follows:

Shore-line surveyed	43 miles.
Roads	10 "
Area of topography, (square miles)	8

Hydrography of Quohog bay, Maine.—The supplementary soundings required in the upper part and on the eastern side of Quohog bay were made by a party in the schooner G. M. Bache, and include about twenty-one square miles additional to the hydrography previously executed by Acting Assistant Alexander Strausz. The locality of the work can be seen by reference to Sketch No. 2.

The statistics of the supplementary hydrography are as follows:

Miles run in sounding	287
Angles measured	1,644
Number of soundings	17,578

The soundings in Quohog bay were completed on the 4th of October. Before taking up this duty Mr. Strausz was employed in a special survey for the Navy Department, of which mention has been made in the introductory part of this report.

Messrs. L. L. Nicholson and Charles Hein served as aids with the hydrographic party in the schooner G. M. Bache in this section.

Boston harbor.—During the past year the work of the United States commissioners connected with the special survey of Boston harbor has been steadily in progress. Assistant Henry Mitchell was specially applied for by the commission at the outset of the year, and with the consent of the department was again assigned to that service. His work in the capacity of consulting engineer and his qualifications are commended in published reports of the city authorities of Boston, and of the State authorities of Massachusetts, the subject of the preservation of that important harbor being of vital interest in the general welfare.

In the same official relation Mr. Mitchell for a short period in the present year acted as advising engineer for the State commission on harbors and flats, with reference to the preservation of Gloucester harbor. With the general information thus communicated, tracings were given to be used for laying down commissioners' lines for preventing encroachments.

Topographical and hydrographic resurvey near Nantucket harbor, Massachusetts.—In October and November a resurvey was made by Sub-Assistant F. W. Dorr of the vicinity of Brant Point. His party at the same time examined the channel leading into the harbor of Nantucket. The following extracts from the report of Mr. Dorr describe the principal changes noticed by comparison with the sheet of the previous survey: "The shore-line of Brant Point has not materially changed, but Coatue Point, on the opposite side of the entrance, has made out a short distance since the original survey."

"The channel has changed entirely, and the best water is now to be found a short distance to the eastward of what was before called the middle channel. This is the only channel now indicated by buoys."

"About the same depth of water can be carried across the bar as formerly by the main channel. Parts of the channel are very narrow, with scarcely room for a vessel to go about."

Sub-Assistant Dorr was aided in this duty by Mr. Franklin Platt, jr. At the opening of the season the party was employed in Section V, and during the summer on the coast of Maine, as already mentioned.

Sow and Pigs reef, (Buzzard's bay, Massachusetts).—At the request of the Light-house Board the reef off Cuttyhunk was examined by Sub-Assistant F. P. Webber, in September last, with reference to its eligibility as a site for a light-house at the entrance to Buzzard's bay. The result of this examination verified the hydrographic survey which was made by Lieutenant Commanding Woodhull in 1853, and confirms the recommendation of the site proposed by that officer.

Mr. Webber landed on the rocks marked No. 1, No. 4, and No. 5 on the Sketch of 1853, and made numerous soundings in their vicinity. The last mentioned (No. 5) is the one known as "Sow Rock" among the fishermen, though a smaller one was designated by that name in the hydrographic survey. He thus remarks in reference to the site before reported: "I coincide in the report made by Lieutenant Commanding Woodhull, that it is the very best place on the reef for a light-house, and find his statements entirely correct, everything being precisely the same as when he examined it."

Topography of Narraganset bay, Rhode Island.—The party of Assistant A. M. Harrison resumed work on the shores of Mount Hope bay on the 8th of January, and continued the detailed survey at favorable intervals of weather until the end of November. Sheet No. 1 of this season embraces the eastern shore between the upper part of Newport island and Globe village. The second contains the details of topography between Warren Neck and the outskirts of the city of Fall River, Massachusetts, and the western shore of Mount Hope bay with parts of its tributaries, Lee's, Cole's, and Taunton rivers. Two other plane-table sheets embrace the survey of the western shore of Providence river, and part of the north side of Narraganset bay, the locality being known as Warwick Neck.

Sub-Assistant Charles Hosmer was attached to the topographical party for a short period in January. He rejoined it on the 9th of October, after completing special duty in another quarter. Mr. A. R. Fauntleroy served as aid until the 17th of March, and Mr. H. G. Ogden after the 9th of August. Both are highly commended in the field report for intelligence and zeal in the service.

The statistics of the work done by the party are as follows, the shore-line being additional to that traced in the preliminary survey of Narraganset bay:

Shore-line	68	miles.
Roads	206	"
Creeks and ponds	55	"
Marsh line	36	"
Area of topography, (square miles)	36¼	

Topography and hydrography of Seekonk river, Rhode Island.—This survey was taken up and completed in May and June by the party of Assistant Harrison, the detailed survey mentioned under the last head being temporarily suspended for the purpose. Two tide gauges were set up, one at Red bridge and the other at India Point bridge, and records of the rise and fall of water were continued for a month. Mr. Harrison was aided in this work by Sub-Assistant F. P. Webber and Mr. Horace Anderson. The plane-table statistics are included in the aggregate already given. In the hydrographic journal two hundred and sixty-seven sextant angles are entered, and seven thousand five hundred and seventy-five casts of the lead.

Hydrography of Narraganset bay, Rhode Island.—The work of sounding in Narraganset bay has been prosecuted in several localities by a party in charge of Sub-Assistant F. P. Webber. In the latter part of June the party joined Assistant Harrison in completing the survey of Seekonk river, as already stated. Supplementary soundings were afterwards made in Newport harbor, and, later in the season, the hydrography of Narraganset bay was extended from Rose island to Beaver Tail light.

In the middle of August the hydrography of Providence river was taken up and extended from the city wharves to Rocky Point, a distance of twelve miles. In connection with the river hydrography tidal observations were made at two stations, one at Nyatt Point wharf, the other at a point below Providence, chosen with reference to the series of observations recorded by Assistant Harrison while sounding in Seekonk river.

Sub-Assistant Webber continued on duty afloat until the 11th of November. The schooner M. L. Stevens was then sent to Newport, and after refitting sailed for Baltimore to be laid up during the winter. In a heavy

northwest gale, off Willoughby spit, the foremast-head was carried away, but eventually she arrived in safety, as intended, on the 30th of November. Mr. A. R. Fauntleroy was attached to the hydrographic party during the entire working season in this section. At different periods he was aided also by Messrs. Horace Anderson, W. W. Harding, Gershom Bradford, and J. A. Guldin.

In the course of the season the party erected eighteen signals and occupied forty-two stations. Thirty-four points on land were determined for the adjustment of soundings. The hydrographic statistics are as follows:

Miles run in sounding	537
Angles measured	7,663
Number of soundings	61,579

The resulting charts have been plotted and are now in the office, with the original note-books, and duplicates of all the journals of soundings, angles, and tidal observations.

Inspection of topography.—In order to secure unity of method and special adaptation of style to the character of the topography, the parties have been visited in the field at intervals of a few years by Assistant H. L. Whiting, whose great experience and highly developed judgment in the representation of topography qualify him specially for giving advice and instruction in reference to its execution.

Within the present season the plane table parties on the coast of Maine were inspected in the field by Mr. Whiting, and a valuable report has been made by him on the system of work best adapted to that coast, the broken and indented outline and bold topographical features of which form so striking a contrast to the coast south of Sandy Hook.

Tidal and magnetic observations.—The tidal observations, by means of a self-registering tide gauge, have been continued at Portland, Maine, under the care of Mr. H. W. Richardson through the entire year. Mr. Richardson has also continued the series of magnetic observations at the same station in Portland. In July he visited Eastport to repeat magnetic observations at the station formerly occupied for the purpose.

At the Charlestown navy-yard tidal observations were also made during the whole year with a box gauge, by Mr. T. E. Ready.

SECTION II.

FROM POINT JUDITH TO CAPE HENLOPEN, INCLUDING THE COAST OF THE STATES OF CONNECTICUT, NEW YORK, NEW JERSEY, PENNSYLVANIA, AND PART OF DELAWARE.

Under this head notice will be taken of the completion of an important link in the primary triangulation of the coast of New England. Measuring along the axis of the triangulation, the two primary bases on which the work depends are four hundred and thirty miles asunder. The geodetic connection of the bases has been discussed by Assistant Schott, chief of the computing division, and the results are given in his paper on the subject in the Appendix, (No. 21.)

The operations of the survey in this section have been continued also in the vicinity of Hudson river; on the south shore of Raritan bay; and on the coast of New Jersey; and the regular tidal observations have been kept up in New York harbor.

Appendix No. 1 contains a statement of the persons employed, their occupation, and the localities in which the parties have been engaged.

Geodetic, astronomical, and magnetic observations.—The connection of the primary base line on Epping Plains, Maine, with the one measured on Fire Island beach, was completed in the course of the season by the party of the Superintendent. As usual in the party, the preliminary arrangements for field duty were made by Assistant G. W. Dean.

Of the two primary stations occupied, both of which connect directly with the Fire Island base, geodetic and magnetic observations were completed at the first on the 27th of June. This station (marked *Ruland* on Sketch No. 1) is in the township of Brookhaven, Suffolk county, New York. The station *West Hills*, in the same county, was afterwards occupied, the transfer of instruments and other preliminaries being as heretofore in the care of Mr. Thomas McDonnell. By the middle of August the measurement of horizontal angles was completed. Observations for the magnetic element were concluded soon after, and field operations were finally closed on the 14th of September.

Of the four heliotrope signals observed from each station, one was fifty-one miles distant from West Hills at station Sandford. Two others were over forty-two miles distant from the theodolite stand. All the lines determined in direction are traced on the progress sketch. The instruments used were the thirty-inch theo dolite, C. S. No. 1; the ten-inch vertical circle, C. S. No. 63; zenith telescope, C. S. No. 5; declinometer D, 22; and the Barrow dip circle No. 6.

At station *Ruland* six hundred and sixty-nine observations were recorded for horizontal angles, and at station *West Hills* eight hundred and thirty-two. For the elevation of signals two hundred and eighty-eight vertical measurements were made with the theodolite at the first-named station, and three hundred at the last. The angular measurements were made by Assistant Dean and Assistant Edward Goodfellow.

Latitude.—At station West Hills two hundred and eighteen observations were made by Sub-Assistant A. T. Mosman, aided by Mr. J. G. Spaulding. Thirty-nine pairs of stars were observed with the zenith telescope. The arc value of the micrometer was determined from one hundred and twenty-two observations on Polaris near its eastern elongation; and the arc value of divisions on the level, from several series of readings in the usual way with the micrometer.

The local time was ascertained from one hundred and fifty-seven observations upon twenty-six zenith and circumpolar stars, with a twenty-four-inch transit, kindly lent for the purpose from the instruments belonging to the corps of United States engineers.

Azimuth.—The astronomical bearings of the trigonometrical lines meeting at *West Hills*, were determined by the method heretofore used in the survey. Assistant Dean, aided by Assistant Goodfellow and Sub-Assistant F. F. Nes, made for the purpose seventy-two observations with the large theodolite upon δ Ursæ Minoris near its upper culmination, and ninety observations on Polaris near its eastern elongation, in connection with one hundred and fifty-two readings on an elongation mark which was favorably located on a hill about two miles distant in a northerly direction from the station.

Magnetic observations.—During three days at station *Ruland* one hundred and forty-three observations were recorded, and at *West Hills* one hundred and ninety-one observations, during four days, for determining the magnetic declination.

Near the first named geodetic station the inclination of the needle was ascertained from six sets of observations at two points. The magnetic inclination at the last named station was determined in the same way by means of two needles. Six sets of deflections and three of vibrations were noted at each station for the horizontal intensity and moment of inertia. These observations were made by Assistant Goodfellow, aided by Sub-Assistants Mosman and Nes.

The usual meteorological journal was kept by daily entries during the season.

All the original records of the geodetic and other operations have been duplicated, and the reductions for latitude, azimuth, and magnetic elements have been completed.

Triangulation east of Hudson river, New York.—Assistant Edmund Blunt has further extended the field-work to connect the primary triangulation of Section I with that of the Hudson river. Five additional stations were occupied in the course of the season. Sub-Assistant J. A. Sullivan was attached to the party after the completion of duty in Section III, and is yet in service with Assistant Blunt in the field. Sub-Assistant A. T. Mosman was also assigned to assist after the middle of October. The statistics of the work are as follows:

Stations occupied	5
Angles measured	95
Number of observations	2, 922

Topography of the highlands of Navesink, New Jersey.—The supplementary topography requisite for the completion of the engraved chart of New York harbor was resumed by Assistant C. M. Bache in the vicinity of the limit reached in a former season by Assistant Harrison. The sheet projected for Assistant Bache will include the entire belt of the highlands. His party is still in the field. A synopsis of statistics returned in advance of closing work for the season is as follows:

Shore-line traced	32	miles.
Roads surveyed	32½	"
Area of topography, (square miles)	10	

Coast triangulation below Barnegat, New Jersey.—The work of revision was resumed by Assistant John Farley, in the lower part of Barnegat bay, on the 1st of August. Going southward additional stations were occupied to Manahawken, and signals erected in the vicinity of Tuckerton were observed on. The field-work was continued until the end of October. The statistics are as follows:

Stations occupied	8
Angles measured	24
Number of observations	900

By the work here mentioned the triangulation has been carried to the vicinity of Absecom inlet.

Topography and hydrography at League island, Delaware river.—At the special request of the honorable Secretary of the Navy a detailed survey was made, in June, of the shores and water passage behind League island, in the Delaware river. The topographical work was done by Assistant R. M. Bache; the soundings were made by Mr. Edwin Hergesheimer.

A chart of the back channel at League island, on a large scale, resulting from the field-work of this season, was completed at the office as soon as possible by Mr. Hergesheimer, and has been forwarded to the Navy Department.

Tidal observations.—The permanent self-registering tide gauge at Governor's island, New York harbor, has been kept in operation by Mr. R. T. Bassett, who has also continued simultaneous observations for comparison with a box gauge at the wharf of the Hamilton Avenue ferry, in Brooklyn.

SECTION III.

FROM CAPE HENLOPEN TO CAPE HENRY, INCLUDING THE COAST OF PART OF DELAWARE, THE COAST OF MARYLAND, AND PART OF THE COAST OF VIRGINIA.

In this chapter notice will be taken of the concluding work in a series of surveys which were commenced and prosecuted at the instance of military authorities during the recent war. Before the opening of the present year all the approaches to the capital had been carefully mapped. During this season the topography of the approaches to the city of Baltimore has been completed, and a survey has been made of the banks of the Potomac between Washington and Harper's Ferry. One of the assistants remained in active military service with the army in the Shenandoah valley until midsummer.

Tidal observations have been continued in this section at Old Point Comfort.

Appendix No. 1 shows in abstract form the names of the assistants and aids employed in the field, and the localities and description of work in which each party was concerned.

Topography of the Patapsco river, Maryland.—The plane-table survey of the vicinity of Baltimore has been continued by Sub-Assistant C. T. Iardella. His second sheet, containing details of surface and the line of defences erected in the western approach to the city, was prosecuted under the direction of Brevet Major C. N. Turnbull. A third sheet, executed by Mr. Iardella, commences at Light Street bridge, on the south side of the Patapsco, and represents the shore as far east as Swan creek, taking in the plane-table features of Curtis's creek, Stone House cove, and Cabin Branch. A special examination was made of the entrance to Curtis's creek, with reference to its suitability as an anchorage for laying up the smaller vessels of the survey.

The fourth sheet, the details of which are now in progress in the field, takes in the opposite shore of the Patapsco below Baltimore, and to the eastward of the city connects with the map of the environs made for military purposes, under the direction of Colonel Reynolds, in 1863–'64.

The statistics of plane-table work done by Mr. Iardella are as follows:

Shore-line traced	22 miles.
Outline of creeks and marsh	65 "
Roads	96 "
Area of topography, (square miles)	30

Triangulation of the Potomac river above Washington, D. C.—In order to connect the several surveys which had been made for military purposes on both sides of the Potomac above Georgetown, Sub-Assistant J. A. Sullivan was detailed, at the opening of the present season, to make a general triangulation between the capital and Harper's Ferry. In connection with this work arrangements were made for extending the plane-table survey, if practicable, to the same point. Mr. Sullivan reported to Brevet Lieutenant Colonel C. Seaforth Stewart, chief engineer middle military division, in November, 1864, and after completing the arrangements for his party, took up the triangulation work at Maryland Heights. Stations were selected on the Blue Ridge and on the Catoctin mountain range, and these, in connection with others lower down the river, effected a junction with the triangulation of the District of Columbia. Eighteen stations were occupied with the theodolite, and about eleven thousand observations were recorded. Besides the nineteen signals erected for use in the triangulation, twenty-five other points were determined for the use of the plane-table party of Sub-Assistant Donn. These points comprise an area of about four hundred and fifty square miles. The field-work was closed on the 24th of August. During May and June Mr. C. S. Hein aided in the party.

Sub-Assistant Sullivan recommends that a station be selected in the vicinity of Aldie, Virginia, and

connected by theodolite observations with those which he occupied at High Knob, Sugar Loaf, Camp Hill, and Tenallytown. This, by force of circumstances, was not practicable within the present season, but being desirable in order to give general command of points within the area already included in the triangulation, will be kept in view as essential to the completion of the work.

After closing work in this section Mr. Sullivan joined the party of Assistant Blunt for field duty in Section II. Mr. Hein was at the same time assigned to aid a party in Section I.

Topography of the Potomac river below Harper's Ferry, Virginia.—Early in October Sub-Assistant J. W. Donn reported at Harper's Ferry to the chief engineer department of West Virginia, Lieutenant J. R. Meigs, and under his direction organized a party for the plane-table survey of the banks of the Upper Potomac. The untimely death of that talented officer, occurring before the party was fully made up, caused some delay, so that field-work was not fairly started until the beginning of November, at which time Major C. S. Stewart, United States Engineers, was in charge of the middle military division as chief engineer. The survey was thenceforward prosecuted under his direction.

"A traverse line was started on the tow-path of the canal, at the points where the Sharpsburg and Harper's Ferry road touches the river, and with this as a base line both shores of the Potomac with the adjacent topography were mapped, together with the Shenandoah river for a mile and a quarter above the junction. This work included the town of Harper's Ferry, Bolivar, and Camp Hill, and all the defensive lines as far to the westward as the summit of Bolivar Heights. The survey of the left bank of the Potomac was extended so as to embrace the northern and eastern defences of Harper's Ferry, and also the stone fort on Maryland Heights. A reconnaissance of Loudon Heights was made, a more careful survey not being practicable, as that district was then subject to frequent incursions from bands of guerillas.

"In March the traverse was extended to Berlin, and a fringe of topography half a mile in width was surveyed on the north side of the river. The shore-line of the south bank of the Potomac in that vicinity was at the same time traced. Field-work became more difficult as the spring advanced, the belt of woods between the canal and the river being an obstruction to lines of sight, but, by taking advantage of cleared hills, the positions of the islands and sufficient points on the opposite bank of the river were determined. On this work as a basis, the Virginia side of the Potomac was mapped from Harper's Ferry towards Great Falls with a considerable degree of accuracy.

"The Blue Ridge range of mountains, where it crosses the river at Weverton, three miles below Harper's Ferry, was surveyed from points furnished by the triangulation of Sub-Assistant Sullivan. The survey of the Catoctin mountain was extended to a station three-quarters of a mile from the Point of Rocks, and the trigonometrical station on Quarry Hill, northward of White's ford, was also included within the limits of the topographical survey.

"From Seneca creek to the Great Falls, a distance of eight miles, the bluffs along the canal are generally heavily wooded, and it was found impracticable to determine points on the south shore of the river with the degree of accuracy usual in plane-table work. Hence, the shore and islands in that stretch of the Potomac were laid down on the sheet as reconnaissance.

"Heavy freshets in the river increased the difficulties of surveying incident to the nature of the surface. Many of the islands were at times under water, and to be known in position only by the trees on their borders. The large cultivated islands, Heter's, Mason's, and Harrison's, were surveyed carefully, but on account of the violent current of the river others could not be reached. In such cases their outlines were determined from the traverse line and hill stations. The traverse line of each sheet was connected with the others by means of common lines, so that the survey, though extending to the length of six sheets, is continuous throughout.

"The topographical elevations were referred to the lockage of the canal, a record of which was furnished by Mr. Fisk, the engineer of that work. Contour lines at successive elevations of twenty feet were carried over the entire area of the survey.

"At Great Falls the survey was connected with that made in the summer of 1861 by Sub-Assistant Dorr, and to perfect the junction of the two sheets of work, the road from the Falls to Offutt's cross-roads was resurveyed. From the cross-roads the river road was surveyed back to Seneca Mills, on the creek of that name, and the area included between that road and the canal was mapped. The survey of the river road, therefore, is continuous from Georgetown to White's Ferry, at which point the road crosses into Virginia."

Every facility required for the effectiveness of the party was supplied, as needed, by Major Stewart, and the large return in statistics may be regarded as evidence of the thorough co-operation of that officer. The abstract is as follows:

Shore-line of river	101 miles.
Shore-line of streams	103 "
Shore-line of islands	71 "
Roads and canal	190 "
Area surveyed, (square miles)	50

Sub-Assistant Donn was aided in the field by Mr. H. L. Marindin until January, and from that time until the close of the season by Mr. McL. W. Thomson.

After depositing in the office his sheets of the survey of the upper Potomac, Mr. Donn took up plane-table duty, which has been mentioned under the head of Section I.

Service with the army in the Shenandoah valley, Virginia—At the date of my last annual report, Assistant J. G. Oltmanns was on duty on the staff of Major General Emory, the army being then on the Opequan creek, near Bartonsville. Here he employed the month of November and part of December, 1864, in making a complete map of the ground occupied by the several army corps under the command of Major General Sheridan. With the corps of General Emory he continued on duty until midsummer, and was then relieved in consequence of failing health.

Tidal observations.—The permanent self-registering tide gauge at Fortress Monroe has been kept in successful operation by Ordnance Sergeant C. Kelly, United States army.

SECTION IV.

FROM CAPE HENRY TO CAPE FEAR, INCLUDING THE COAST OF PART OF VIRGINIA, AND OF PART OF NORTH CAROLINA.

Two of the parties sent for duty at the south during active military operations, were attached to the army of Major General Sherman. Three others were under the orders of Admiral Porter. In addition to a special survey made of the approaches to Goldsboro', North Carolina, before the conclusion of the war of the rebellion, it will be seen that the regular work on the coast has been advanced in the vicinity of Cape Lookout and Cape Fear. The chief of one of the parties served as light-house inspector for the coast of North Carolina during the most important period in the naval and military operations in this section.

Appendix No. 1 shows in tabular form the parties employed on the coast of North Carolina and in other sections of the survey.

Service with the army between Savannah and Goldsboro', North Carolina.—While military operations were in progress in the vicinity of Chattanooga, several of the topographers of the Coast Survey were engaged in making plane-table surveys under the direction of Colonel O. M. Poe, of the corps of engineers, and their aptitude had to some extent identified them with the movements in that quarter. Of these, Sub Assistants Cleveland, Rockwell, and F. W. Dorr rejoined the army of Major General Sherman at Savannah, and again reported to Colonel Poe, the first-named on the 10th, and the latter on the 22d of January. Two aids, Messrs. W. W. Harding and Franklin Platt, were assigned to assist in any plane-table surveys that might be needed in the intended march of the army northward across the State of South Carolina. The parties left Savannah on the 26th, and two days after rejoined headquarters, then at Pocotaligo. During the stay at that point a plane-table survey was made of the rebel works and of the approaches to them. Proceeding with the right wing of the army, Messrs. Rockwell and Dorr reached Columbia, South Carolina, on the 17th of February, and Winnsboro' on the 21st. There, joining the left wing, they crossed the Catawba on the 24th, at Rocky Mount, and again met the right wing on the 4th of March at Cheraw. Fayetteville, North Carolina, was reached on the 11th, where the army halted until the 14th of March. In the arsenal at that place some topographical instruments, which had been used by the party working on the coast of North Carolina previous to the year 1861, were recovered and forwarded to the office.

The forward movement of the army being opposed only at Averysboro', where the enemy made a stand on the 16th, but gave way in the night, the columns moved on and occupied Goldsboro' on the 23d of March. Here a plane-table survey was at once commenced on two sheets, the intention of the commanding general being, if necessary, to hold the place with a small garrison. Sub-Assistant Dorr surveyed the ground west of the Wilmington and Weldon railroad, and Sub-Assistant Rockwell the section lying east of that line.

General Sherman's second campaign was opened on the 10th of April by a movement on Raleigh, North Carolina, which was occupied without resistance three days after, and on the day following the forward movement was terminated by overtures for surrender from the commander of the rebel forces in North Carolina. Messrs. Dorr and Rockwell accompanied the army in its march on Raleigh, but the capture of a detailed map

of the defences of that city rendered it unnecessary to resume work with the plane table. The parties were relieved from further service with the army at Raleigh in the latter part of April, and reported at the Coast Survey office.

Under the head of Section I notice has been taken of the subsequent occupation of Sub-Assistants Rockwell and Dorr.

Hydrography in the vicinity of Cape Lookout, North Carolina.—The survey of the Cape Lookout shoals was commenced in the latter part of May, and soundings on them were continued during the three following months, and during the month of November, with only such interruptions as were due to unfavorable weather.

As these shoals extend about eleven miles seaward, nearly in the direction of the sharp point of the cape, the usual method of determining positions by measuring horizontal angles on shore stations proved impracticable. Recourse was therefore had to floating signals. Iron buoys, well secured by mushroom anchors, were used for the purpose, and the positions were made conspicuous by attaching boats with stepped foremasts. The buoys were placed so as to form a chain of triangles in connection with the regular coast stations of the triangulation. Angles at the buoys were checked by angles from Cape Lookout light-house, and by these means a degree of accuracy equal to that of ordinary harbor surveys was secured.

Besides the survey of the shoals off Cape Lookout, lines of soundings were carried along the coast between Cape Lookout and Cape Fear.

This work was executed by a party in the steamer Corwin, under the command of Acting Master Robert Platt, U. S. N., who was ably seconded by the intelligence and experience of Mr. Charles Junken. The operations of the present year for the development of the Cape Lookout shoals, confirm the observations made last season by Lieutenant Commander Phelps in his reconnaissance of the locality. A general statement of the results of the regular survey, furnished by Mr. Junken, is given in the Appendix (No. 4) as derived from a careful study of the chart. More than eleven thousand soundings were taken by the party on the shoal grounds alone. The aggregate statistics are as follows:

Miles run in sounding	1,417
Angles measured	495
Number of soundings	13,244

The tides were observed at Fort Macon wharf while the hydrographic work was in progress.

Acting Master Platt acknowledges the indebtedness of the party of Lieutenant Commander W. C. West, U. S. N., for his kindness in facilitating by all means in his power the prosecution of the hydrography. Special mention is also made of the efficiency of Mr. A. M. Weatherill, the hydrographic aid, and of the earnest co-operation of Acting Ensigns C. J. Rodgers and G. H. Barry, U. S. N.

Light-house service.—In view of the interests connected with active naval operations on the coast and in the waters of North Carolina, Acting Assistant Edward Cordell had been assigned, at the request of the Light-house Board, to serve as inspector, and was in the discharge of that duty at the close of the last surveying year. His experience, moreover, in hydrographic surveying, and ready acquaintance with the means of defining the changes to which bars and channels are liable in this and other southern sections, concurred in that assignment, as it so fell out that interests of more than ordinary magnitude depended in some measure on a thorough knowledge of the actual channel into Beaufort harbor, North Carolina; at any time, however, the sailing courses might of necessity be changed within any given period. This was the allotted port of entry for the transports with supplies for the army of Major General Sherman on its march into the State of North Carolina. It was also the rendezvous of the squadron of Admiral Porter for the naval attack intended on the rebel defences of the Cape Fear river. Under orders from the admiral, suitable buoys were set in New inlet by Mr. Cordell, for the use of the squadron after the capture of Fort Fisher. For the same end the light on Bald Head and the bug lights on Oak island were repaired. The buoys were placed in accordance with changes noticed in a rapid examination of the channel at New inlet, in advance of the general hydrographic resurvey of that and of the western entrance, which was in the course of the season completed by Sub-Assistant Bradford, as will be presently noticed. Notices to Mariners and Sailing Directions were prepared by Mr. Cordell to suit the alterations which had taken place at Beaufort and at the mouth of the Cape Fear. After completing his chart of the resurvey of Beaufort entrance, and turning in the journals connected with it, Mr. Cordell made preparation for taking active hydropraphic service on the western coast. His service in the latter part of the present season will be noticed under the head of Section X.

Hydrography of the Cape Fear entrances, North Carolina.—Previous to the attack on Fort Fisher, in December last, Sub-Assistant J. S. Bradford made several reconnaissances abreast of the defences, one in

particular for tracing the line of eighteen feet water, and another to a point in the immediate vicinity of Fort Fisher. He remained on the staff of Admiral Porter, and served as aid during the successful attack of the 14th and 15th of January. After the surrender Mr. Bradford made a careful detailed survey of all the defences at the mouth of the Cape Fear, and forwarded to this office the sheet representing them in their relative sizes and positions. In mapping the defensive works at New inlet he was aided by Acting Assistant Paymaster A. B. Poor.

When relieved from duty on the flag-ship Malvern, Mr. Bradford made arrangements for prosecuting a complete hydrographic resurvey of the Cape Fear entrances. For this duty Admiral Porter had placed at his disposal the steamer Hetzel. Work was commenced at the western bar early in June, and was pushed as vigorously as the weather would permit, so that the bar and the river, as far as Smithville, were nearly sounded out before the southwest winds had set in with the violence and regularity usual in the summer season. These hindering the final completion of the hydrography there, the party was transferred to New inlet, and from time to time, by taking advantage of favorable turns of weather, the sounding of both bars was continued, and the survey brought to a close on the 12th of August.

The shore-lines of New inlet were resurveyed by Sub-Assistant Bradford, and appear on his hydrographic sheet of that entrance.

Messrs. H. M. De Wees and J. J. Gilbert were attached to the party as aids during the season, and Mr. William B. McMurtrie served as draughtsman during June and July. Tidal obrervations were made at three stations, one at Fort Johnson wharf, one at Fort Caswell wharf, and the third at Fort Buchanan.

The general hydrographic statistics are as follows:

Miles run in sounding	501
Angles measured	3, 726
Number of soundings	60, 370

Sub-Assistant Bradford has turned in at the office his charts of the Cape Fear entrances, with records of the soundings, angles, and tidal observations. His remarks on the changes, developed by comparison with the previous hydrographic survey, will be found in the Appendix, (No. 5.)

SECTION V.

FROM CAPE FEAR TO ST. MARY'S RIVER, INCLUDING PART OF THE COAST OF NORTH CAROLINA, AND THE COAST OF SOUTH CAROLINA AND GEORGIA.

As noticed in describing work in the adjoining northern section, the duties of all the parties sent to Section V connected them intimately with the naval and military forces which were operating on the coast of South Carolina and Georgia during the winter and spring of the present surveying year. Under the orders of Admiral Dahlgren a careful resurvey has been made of the water approaches to Charleston, South Carolina, and of the obstructions placed in that harbor by insurgents during the course of the recent war. For the use of the South Atlantic blockading squadron the Coosaw river and inside passage between St. Helena sound and Port Royal sound were surveyed, as also the upper part of Broad river and Whale branch, and the lower parts of all the rivers emptying into Wassaw sound and Ossabaw sound. For military purposes an extended reconnaissance was made of all the land approaches to the city of Savannah.

The work to be now described will be stated also in condensed tabular form in Appendix No. 1.

Hydrographic resurvey of Charleston entrance and harbor, South Carolina.—The party serving with the South Atlantic blockading squadron at the date of my last annual report was reorganized in December, 1864, for duty on the coast of South Carolina with the surveying steamer Bibb, and remained in charge of Assistant C. O. Boutelle. Under his direction Sub-Assistant R. E. Halter, with a separate party in the schooner James Hall, had started field-work near Port Royal, but was recalled to Charleston early in March, and joined the hydrographic party in a resurvey of the channels leading into the harbor. Continued easterly winds soon made it inexpedient to work efficiently with the schooner, but all favorable intervals were employed by the party in the steamer until the end of June, when the resurvey was completed.

The triangulation requisite for determining the positions of signals used in prosecuting the hydrography was made by Mr. Halter. Eight stations were occupied and about a thousand observations of horizontal angles were recorded. The statistics of the hydrographic resurvey are as follows:

Miles run in sounding	1, 200
Angles measured, (sextant)	10, 884
Number of soundings	78, 646

Early in June the party in the schooner again reported to Assistant Boutelle, and aided in completing the hydrography.

This resurvey includes all the approaches to Charleston harbor, and to the northward and eastward extends beyond Rattlesnake shoals. The results are shown in the chart which is given as Sketch No. 14 with this report. The hydrography done this season embraces also the bar and, generally, all the shoal ground found in the approaches. The harbor itself was thoroughly sounded out, and the lower parts of Ashley and Cooper rivers abreast of the Charleston wharves, making in the aggregate an area of sixty square miles.

Under the direction of Mr. Boutelle, the steamer Bibb was commanded by Acting Master Robert Platt, and, as during the previous working season, the party was subject to the immediate orders of Admiral Dahlgren, flag-officer of the South Atlantic blockading squadron.

Messrs. Gershom Bradford, L. A. Sengteller, J. A. Guldin, and A. C. Mitchell, served as hydrographic aids. Sub-Assistant Halter was aided by Mr. J. W. Brown.

The tides were observed by means of a gauge kept in operation at Castle Pinckney, while the soundings were in progress.

Obstructions in Charleston harbor, South Carolina.—Under the orders of Major General Gillmore, the artificial obstructions placed in Charleston harbor by the insurgents were examined and reported on in March last by Sub-Assistant W. H. Dennis. The report, addressed to General Gillmore, was accompanied by a chart showing the actual position of each structure and by drawings illustrating the modes of construction. This information was obtained by personal examination after full and free conference with parties who had been employed at various times in placing or shifting the obstructions. The position and character of the torpedoes relied on as parts of the system of defences, were included in the examination of Mr. Dennis. All the information thus procured was compiled under the direction of Assistant Boutelle, with other particulars of interest in connection with the operations of the South Atlantic blockading squadron, and in the form of a special chart of Charleston harbor, has been furnished to the Navy Department.

The services rendered by Sub-Assistant Dennis in the military department of the south, are warmly commended in a communication which was addressed to me by Major General Gillmore in May last.

Topography of the Coosaw river and Inside Passage, South Carolina.—Late in March, the regular plane-table work in this section was resumed by Sub-Assistant Dennis. Connecting with the limits of his previous survey on Beaufort river, the topography was extended upwards to the Coosaw, and then the shores of the Coosaw were surveyed from Port Royal ferry to a point near its mouth, where the sheet of Mr. Dennis joins with a survey made by Assistant Seib. The work of this year completes the shore-line survey of the inside passages between St. Helena and Port Royal sounds, and comprises the following statistics:

River shore-line	86 miles.
Creeks	294 "
Marsh line traced	35 "

After completing this work, Sub-Assistant Dennis selected a location for a railroad from Land's End, on St. Helena island, to connect with the Charleston and Savannah railroad in the vicinity of Salkehatchie. That service was performed under the orders of Major General Gillmore at the close of May. The party was then relieved from further duty in the military department, and proceeded to Section I, under which head in this report mention has been made of its subsequent labors.

Triangulation, topography, and hydrography of Broad river, South Carolina, and Whale Branch.—At the request of Admiral Dahlgren, a hydrographic reconnaissance was made in the upper part of Broad river by Assistant Boutelle in December, 1864. For the more extended survey desired in that quarter, the schooner James Hall was fitted out and left Portland on the 3d of January in charge of Sub-Assistant Halter. After reporting to Assistant Boutelle, at Port Royal harbor, the triangulation work was taken up at a line which had been determined across the lower part of Broad river, in the previous survey of Port Royal sound. From thence upward stations were occupied on both sides of the river, and signals determined for the plane-table survey, to embrace also the lower part of the tributaries known as Coosawhatchie and Pocotaligo rivers. The lower part of Whale Branch was included in the triangulation, and the whole of it in the topgraphical survey.

The work on this part of the coast was suspended during March, the party being then employed, as already stated, in the vicinity of Charleston. Tidal observations were recorded for a month in Whale Branch after

the resumption of duty in April, and by the 8th of June the river was thoroughly sounded with reference to the junction of its topography and hydrogaphy with sheets containing the detailed surveys previously made.

The following is a summary of the statistics:

Signals erected	18
Stations occupied	16
Angles measured	62
Number of observations with theodolite	1,629
Shore-line surveyed, (miles)	91½
Marsh-line traced, (miles)	33
Hydrographic signals determined	47
Miles run in sounding	202
Sextant angles measured	2,081
Number of soundings	19,548

Sub-Assistant Halter, in the field report, commends the industry and care shown by his aid, Mr. J. W. Brown, and the hearty co-operation of the sailing master, Captain Leonard Grant, in all the plans for work.

Topographical reconnaissance near Savannah, Georgia.—By direction of Major General Foster, to whom he had reported at Port Royal in accordance with instructions, Sub-Assistant Dennis went to Savannah on the 27th of December with his party in the schooner Caswell. His orders were to make a reconnaissance of the approaches to the city, and he was thus employed until the 1st of March. The result was a comparatively accurate map of all the country east of the railroad from Charleston to Savannah, and east of the Savannah and Gulf railroad, and from the Broad river, in South Carolina, to the Ogeechee, in Georgia. Of this district, the entire coast-line and its immediate topography had been mapped in the regular operations of the Coast Survey. On that work therefore as a basis, Sub-Assistant Dennis pushed his reconnaissance inland to the limit called for by the military authorities. A considerable part of the details were found ready for compilation, in the shape of local maps which, in the course of the rebellion, had been made by the insurgents for defensive purposes. The roads, however, fortifications, and other special features in the vicinity of Savannah, were surveyed by Mr. Dennis with the plane table, and combined with the best of the material otherwise procured.

A copy of the resulting map was as quickly as possible furnished to Major General Gillmore, then commanding the department of the south. The original sheet is now on file in the Coast Survey office.

Sub-Assistant Dennis was efficiently aided in this section by Mr. F. D. Granger.

Topography and hydrography of the dependencies of Wassaw sound and Ossabaw sound, Georgia.—The regular survey below Savannah river has been extended further inland by the party of Sub-Assistant Clarence Fendall. His work, embraced on two plane-table sheets and two hydrographic sheets, represents all the navigable water-courses that fall into Wassaw sound and Ossabaw sound. Among the principal of these are Wilmington river, Vernon river, and the Great and Little Ogeechee rivers, of which the entrances only had been surveyed in connection with work done in former years in the two sounds. The topography of the Ogeechee and its soundings were extended up to Hardwick. The inside passage by way of Burnside river was sounded out, and, generally, all the navigable waters to the southward of the city of Savannah. The plane-table survey carried on at the same time included, in addition to natural features, all the defensive works erected in the south approaches to Savannah.

Sub-Assistant Fendall was aided in this duty by Mr. Stehman Forney.

The hydrographic work was done by the same party, under the direction of Assistant Boutelle, with vessels assigned during the winter of 1864–'65 by Admiral Dahlgren. The survey was completed by the end of June. Acting Master James Ogilvie, of the schooner John Griffiths, steadily co-operated with Sub-Assistant Fendall in furnishing means and facilities for pushing the hydrography. Mr. Forney, the aid, is warmly commended in the field report for steady application and intelligence in the discharge of his duties.

While the work was in progress in this vicinity, the tides were observed and recorded at two stations in Wilmington river, and at a station in the lower part of the Ogeechee.

The hydrographic statistics are as follows:

Miles run in sounding	215
Angles measured	1,961
Number of soundings	18,969

Tidal observations.—Considerable difficulty was experienced in establishing a gauge for self-registering

observations at Bay Point, (Port Royal, South Carolina.) from the fact that the necessary stability could not be obtained on the wharf built at that place for military purposes. Under the direction of Assistant Boutelle, a new site was selected and a wharf built on which the self-registering tide-gauge was placed on the 20th of August. Previous to that date the observations were made partly by means of a staff and partly with a tape gauge. The observer is Mr. E. M. Converse.

SECTIONS VI, VII, VIII, AND IX.

FROM ST. MARY'S RIVER TO THE RIO GRANDE, INCLUDING THE COAST OF FLORIDA, ALABAMA, MISSISSIPPI, LOUISIANA, AND TEXAS.

The results of the work of previous years have been made available within the present season for the completion and issue of two engraved sheets of the first class, comprising the principal part of the Florida reef and keys. These, with the two sheets before published, complete the chart of the reef on the scale of $\frac{1}{80000}$.

The series of magnetic observations continued for several years at Key West, as referred to in former reports, will terminate at the close of the present season.

Until the close of the rebellion, parties which were accustomed to work on the Gulf coast before the war, were attached either to the army of the southwest or to the Mississippi squadron. Their concluding labors in that connection will be referred to in this chapter. Although the surveys on the Mississippi and Tennessee rivers were induced by the condition of hostilities which prevailed while the work was carried on, it is believed that the results are of permanent importance.

Appendix No. 1 comprises in tabular form the names and occupation of persons employed in all the sections of the work.

Magnetic observations at Key West.—The series of magnetic observations, both absolute and differential, which have been carried on at Key West since February, 1860, now extend over a period sufficient to furnish the results for which they were undertaken, and it is proposed to discontinue them at the end of the present year. During the present season the temporary observatory and the instruments and records have been, as heretofore, in the charge of Mr. Samuel Walker.

Topography of Lookout mountain, Tenn.—During the greater part of the season Sub-Assistant C. H. Boyd continued on duty in the military division of the Tennessee, attached to the staff of Major General Thomas. At the expiration of sick leave he again reported at headquarters in the middle of January, and later accompanied General Tower, inspector of fortifications, on a tour to Chattanooga, where, from fatigue and exposure, the aid of the plane-table party, Mr. C. P. Dillaway, was taken ill, and so rendered unable for further field duty.

By order of Colonel Merrill, chief engineer of the military division, Sub-Assistant Boyd commenced on the 20th of March a plane-table survey of the summit of Lookout mountain, embracing particularly the ground which had been indicated for defences, and the approaches to the intended works. In addition to this sheet of detailed survey, a reconnaissance sketch was made to represent a compass of about sixteen miles beyond the plane-table limits. Thirteen miles in the aggregate were run with the level, and grade stakes were set at every change of ground surface.

In May, Mr. Boyd improved the opportunity afforded by a military reconnaissance to extend the limits of his survey made in the previous year of the battle-field of Chickamauga. The addition of the details here alluded to had been at that time suspended by the approach of a hostile force.

Engineer operations were for a time suspended by changes incident to the close of the war and by the organization of the new division of the Tennessee. The party was in consequence relieved, and Mr. Boyd returned to the office early in July. Mr. Dillaway remained at Chattanooga in charge of the instruments, so that any further call for service by the military authorities might be met without delay.

Mississippi river, (reconnaissance.)—The connection of the party of Assistant F. H. Gerdes with the naval forces acting in the Mississippi waters has further extended the development of this great channel of intercommunication. A stretch of one hundred and fourteen miles, comprised between Cairo, Illinois, and St. Mary's, Missouri, was mapped in the spring of the present year in conformity with special instructions, the tenor of which may be gathered from the following indorsement made by Rear-Admiral S. P. Lee on the final report addressed to that officer by Assistant Gerdes: "The within report is heartily approved. It has been very desirable to have a good reconnaissance made of the Mississippi below St. Louis, the Tennessee, the Cumberland, and the lower Ohio. I placed the gunboat Curlew at the disposition of Mr. Gerdes and his party for this purpose, and instructed navy officers and requested army officers to give them

facilities." * * * * * "The military and naval operations on the Tennessee affording protection for a reconnaissance, I desired that it should show between Paducah and Muscle shoals the rate of current at different stages of water, the location of ferries, and the description and length of roads connecting them with the nearest towns; the relative depth of water on significant or commanding bars at different stages; and permanent and convenient bench marks made on bridge piers, &c.; and that a table of distances should be given. The work so far has been as well executed as practicable under the embarrassment of very high water. When completed it will be very useful to the navy, the army, and the public generally, and creditable to the Coast Survey. My cordial thanks are given to Assistant Gerdes and his party for their intelligent and valuable services."

At five stations, viz: Cairo and Chester, Illinois, and Cape Girardeau, Wittenberg, and Illinois Station, Missouri, the latitude and longitude and the magnetic declination were determined by Sub-Assistant A. T. Mosman. The results found for the survey of the Mississippi are given in Appendix No. 10, with tables of distances between the points embraced in the operations of the past two seasons.

This reconnaissance was made in continuation of the service directed last year by Admiral Porter, the results of which appeared in three sheets combined with the sketches of the annual report for 1864. The survey between Cairo and St. Mary's is represented in this volume by three sheets marked as Sketches Nos. 16, 17, and 18.

Of five thousand three hundred and forty observations recorded in determining positions on the Mississippi, the Ohio, and the Tennessee rivers, all those for time and latitude were made with the vertical circle No. 57, mounted on a solid block of wood. The latitude was determined from observations on north and south stars while on or near the meridian; the time, from east and west stars near the prime vertical, and from observations on the sun. The longitude was obtained by transporting two chronometers, one sidereal and the other marking mean time, with a probable error on the average in final results of $0^s.5$.

Assistant Gerdes was aided by Sub-Assistant T. C. Bowie and by Messrs. A. R. Fauntleroy and J. B. Adamson. Mr. F. W. Perkins served as astronomical aid and recorder. After furnishing to Admiral Lee complete copies of the surveys, Assistant Gerdes forwarded the original sheets to the office, with records in duplicate of the observations for geographical positions and magnetic declination.

The steamer Curlew was assigned for the use of the party by Captain A. M. Pennock, United States navy, on the 27th of October, 1864, that officer being in command at Mound City when Mr. Gerdes reported for service. The great personal interest subsequently manifested by Admiral Lee, and which was shared by the division commanders and captains in the Mississippi squadron, very materially favored the prosecution of these important surveys, the second of which will now be brought under notice, regard being given rather to natural order than to the part of the season employed in the several localities. The work on the Mississippi above the mouth of the Ohio was commenced on the 16th of March and concluded by the 1st of May. Between the astronomical stations the bends of the river and the distances were determined by careful compass triangulation. In the latter part of June the party made, at the request of the admiral, local surveys of magazine grounds at Jefferson barracks, Missouri, and sites for ordnance and supply depots.

Tennessee river, (reconnaissance.)—The map of the Tennessee, by the party of Assistant Gerdes, shows on a large scale the courses of the river between Paducah and the Muscle shoals, its bars, the position of ferries, the topography of its banks, and other particulars called for by the directions of Admiral Lee.

Captain Pennock being in command when the party reported for duty at Mound City at the end of October, 1864, Sub-Assistant Bowie and Mr. Adamson were, at the request of that officer, detailed to accompany a naval detachment intended for service in the Tennessee river. With the steamer Curlew the party made the necessary reconnaissances as far up as Forts Henry and Heiman, and, after furnishing sketches of the river for the respective commanders, returned to Mound City on the 8th of November. Several months following that date were employed in surveys for navy-yard sites in the western waters, in which Mr. Gerdes engaged in person, leaving his party to prosecute the survey of the Tennessee. Taking charge of the work again on the 3d of March, he extended the reconnaissance as far as Clifton, and several astronomical stations were added to those which had already been occupied. The stage of water soon after not being favorable, the survey of the Mississippi before alluded to was taken up, and work on the Tennessee deferred until the 11th of April. From Clifton the topographical reconnaissance was extended to Florence, Alabama, and was there concluded on the 20th of April. Two hundred and sixty-two miles of the course of the river are represented in the survey. Ten astronomical stations were occupied for the determination of latitude, longitude, azimuth, and magnetic declination. The distances between the stations were inferred from the ascertained

rate of the Curlew in steaming from point to point, reference being made at the same time to local maps, and for purposes of comparison to reputed distances as reported by pilots.

Sub-Assistant Bowie and Mr. Adamson sounded on all the shoals of the river below Eastport, and while so doing kept a record of the rise and fall of water at three different places. This service was completed on the 23d of June.

The map of the Tennessee, in sixteen sheets of convenient size, has been engraved on stone at the Coast Survey office, and is now ready for issue. Sketch No. 19 is a general map of the river, marked with the several sheets just mentioned.

Navy-yard sites in western waters.—While working with his party in the survey of the Tennessee river in November, 1864, as detailed under the last head, Assistant Gerdes was directed by Rear-Admiral Lee to accompany the commission which was authorized by the last Congress to examine and report on sites for a navy-yard in the western waters. In accordance with instructions Mr. Gerdes reached St. Louis in the Curlew on the 22d of November and reported to Admiral Davis, the chairman of the commission, for duty as topographer. In the course of a month surveys were made of sites at St. Louis, Carondelet, Evans's Landing, Cape Girardeau, Cairo, and Memphis, on the Mississippi river; and at Mound City, Fort Massac, Louisville, Cincinnati, and Pittsburg, on the Ohio.

Mr. Gerdes accompanied the commission to Washington city, and until the first of March was employed in drawing maps and plans of the several localities under consideration, and in supervising the engraving of the same for the report of the naval commissioners. He then returned and resumed the charge of his party on the Tennessee, as already stated. By direction of Admiral Lee the party was employed about a fortnight in June at Mound City, in running lines of level around the town and naval station, and in computing the requirements for a new levee, so as to secure the vast government interest in ordnance and supply stores from the frequent and disastrous floods of the Ohio.

SECTION X.

FROM THE SOUTHERN BOUNDARY ON THE PACIFIC OCEAN TO THE FORTY-SECOND PARALLEL, INCLUDING THE COAST OF CALIFORNIA.

On the coast of California the operations of the survey in triangulation, topography, and hydrography have been actively pushed between Monterey bay and San Francisco entrance. A special survey of Rincon Rock and Blossom Rock will be referred to in the detailed notices of work. The off-shore hydrography done this season has availed for the issue of a chart of the coast between Point Pinos and Bodega Head, which, like others of its class, (see Sketch No. 22,) is published in advance of the engraved topography requisite for its final completion.

The arrangement of parties for work in this and the other sections of the coast is shown in tabular form in Appendix No. 1, and, as in other instances, the notices now to be made of the work in each locality will conform to the same arrangement.

Coast triangulation north of Monterey bay, California.—The secondary triangulation passing along the coast of California was resumed at Point Año Nuevo by Assistant W. E. Greenwell, and has been extended to Half Moon bay. It was there joined with previous work which had already been connected with the main triangulation of San Francisco bay. In carrying on this duty Mr. Greenwell co-operated also with Assistant Rodgers by furnishing points for his topographical party, and with Acting Assistant Cordell by determining the positions of mountain peaks to serve as signals in running lines of soundings off-shore. The party took the field at midsummer, and closed for the season in the middle of October.

Sub-Assistant Julius Kincheloe assisted Mr. Greenwell in the triangulation and in computing the results of field observations. The points determined serve to define the coast line to a distance of about twenty-six miles below Half Moon bay.

Topography of the coast.—The plane-table survey of the coast of California, north and south of Half Moon bay, has been continued by the party of Assistant A. F. Rodgers. It is expected that the work of the present season in that vicinity will close the only interval in the topography between Point Pinos and Bodega Head, and thus facilitate the completion of the chart between those limits, which in preliminary form is given as Sketch No. 23 with this report.

Assistant Rodgers has been aided, as heretofore, by Mr. A. W. Chase.

Hydrography south of San Francisco entrance, California.—Acting Assistant Edward Cordell reached

San Francisco on the 26th of June, and at once took charge of the hydrographic party, the operations of which had been temporarily conducted by Assistant Edwards. With the schooner Marcy the coast hydrography abreast and to the southward of Half Moon bay was taken up early in July and prosecuted vigorously until the close of the season. Point Año Nuevo was reached by the 1st of October, and additional lines run off-shore during that month extended the work to a connection with the soundings made in a previous year in Monterey bay.

The off-shore lines of soundings were adjusted in place by the previous determination of the positions of mountain peaks with reference to the shore stations of the triangulation. This important preliminary for the hydrographic work was performed by Assistant Greenwell. Soundings were extended to the depth of three hundred fathoms. South of Point Año Nuevo the hundred-fathom curve tends somewhat in-shore, and the steepness of the bottom slope is much greater.

"From Point Pedro to Pigeon Point the lines of soundings average about twenty nautical miles, measuring from the coast. In going southward they gradually shorten to ten miles between Point Año Nuevo and Santa Cruz—the curve of one hundred fathoms running in that vicinity nearly parallel to the shore, at a distance of about eight miles. The deepest sounding (335 fathoms) was obtained, together with a specimen of the bottom, about midway between Point Año Nuevo and Santa Cruz, at a distance of only eight miles from shore."

The following are statistics of this work:

Miles run in sounding	288
Casts of the lead	583
Angles for position of vessel	1,190

Hydrography: Rincon Rock and Blossom Rock, (San Francisco harbor.)—A special and detailed examination of the vicinity of these dangers to navigation was made last spring at the request of the San Francisco Chamber of Commerce by the party of Assistant W. S. Edwards. Assistant Lawson being at that time in the vicinity, assisted in making the soundings. The removal of Rincon Rock being then under consideration, Mr. Edwards reported the following particulars to A. B. Forbes, esq., agent of the Pacific Mail Steamship Company: "The least water found on the rock was five feet at low water, spring tides. The crown of the rock has an area of twenty square yards with this depth."

"The depth of ten feet extends over an area of two hundred and eighty-seven square yards; the depth of fifteen feet over an area of five hundred and thirty square yards."

Triangulation of Suisun bay, California.—During the month of September, 1864, the party of Assistant J. S. Lawson remained at work on Suisun bay. Four new signals were erected for theodolite observations, and several were set up for the use of the hydrographic party. Five stations were occupied, and thirty-eight angles were measured by twelve hundred and eighty observations.

Returning to San Francisco early in October, Mr. Lawson computed the results of his triangulation, and forwarded abstracts of his office-work with the records of the triangulation in duplicate. The subsequent work of this party will be mentioned in the next section.

Dragon Rocks.—The recent loss of a steamship on the Dragon Rocks or Crescent City reef during very thick weather, gives occasion to again point attention to the existence of a wide and safe passage through that reef. The preliminary hydrographic reconnaissance developed this passage inside the Dragon Rocks, and showed it to be one mile in width, with ten fathoms of water through the middle course. It has since been regularly used by the mail and coasting steamers. The reef is described by Assistant George Davidson in his Directory for the Pacific Coast, and descriptions of it were inserted in the Appendix of the annual reports for 1858 and 1862.

Tidal observations.—The self-registering tide-gauges at San Diego and San Francisco have been kept at work successfully by Messrs. A. Cassidy and H. E. Uhrlandt, under the supervision of Captain G. H. Elliot, of the corps of United States engineers. Mr. Uhrlandt, has also continued, as heretofore, to read off the sheets of the self-registering gauges of the western coast previous to sending them to the office in Washington. Valuable meteorological records have, as in previous years, been kept at these stations.

SECTION XI.

FROM THE FORTY-SECOND PARALLEL TO THE NORTHWESTERN BOUNDARY OF THE UNITED STATES, INCLUDING THE COAST OF THE STATE OF OREGON AND THE COAST OF WASHINGTON TERRITORY.

The results of the work done in this section by the single party available for the service have been added to the chart of Koos bay. The chart is given as Sketch No. 24 with this report.

The distribution of all the parties working on the western coast is given in Appendix No. 1.

Hydrography of Koos bay, Oregon.—This work has been continued by the party of Assistant J. S. Lawson. The soundings made in the course of the summer embrace about two-thirds of the entire bay, and but little remained to be done at the date of the last report to bring the work into connection with the soundings made in previous years by the same party. From the observations already made by Assistant Lawson, the bars of this bay appear to be subject to great changes. The hydrography of the present season comprises the following:

Miles run in sounding	154
Angles observed	1,506
Number of soundings	14,094

Tidal observations were recorded as usual while the soundings were in progress.

The previous service of this party has been noticed under the head of the preceding section.

Orford reef.—A reconnaissance-sheet showing soundings in the vicinity of the Orford reef has been turned in by Assistant George Davidson. His examination exhibited a straight passage one mile and a half wide, with ten fathoms of water on the middle course through it. A detailed hydrographic survey of the vicinity will be made as soon as practicable. The passage here referred to is described in the Directory for the Pacific Coast of the United States, copies of which were given in the appendix of the annual reports for 1858 and 1862.

Harbor of refuge.—The want of a harbor of refuge on the coast of Washington Territory has long been felt by navigators in contending against the southerly gales of winter.

Assistant Davidson has called attention to the importance of an examination of the vicinity of Destruction island, in latitude 47° 41′ north, that being the only place on the northwestern coast likely to afford the desired protection. The extent and elevation of the island, its distance from the mainland, and the depth of water in the vicinity, seem to favor the selection. Vessels trading to the Columbia river, Shoalwater bay, Gray's bay, the strait of Fuca, gulf of Georgia, Fraser's river, Bellingham bay, Admiralty inlet, Puget sound, and Hood's canal are very frequently compelled to keep at sea for weeks by stress of weather. A light properly located on the island or on the reef would doubtless be necessary as a guide for approaching the harbor of refuge. This locality is described in Mr. Davidson's Directory, (annual reports for 1858 and 1862,) and will be specially examined with reference to its availability for the purpose suggested.

Tidal observations.—The self-registering tide-gauge at Astoria has remained in charge of Mr. L. Wilson, under the supervision of Captain G. H. Elliot, of the corps of United States engineers. The very complete meteorological records kept by Mr. Wilson have been continued as heretofore.

COAST SURVEY OFFICE.

The office in Washington city, in which the details dependent on the field-work, such as computations, projections, hydrographic revision, drawing, engraving, electrotyping, map printing, &c., are worked out, has been continued under the direction of J. E. Hilgard, the assistant in charge.

As the materials and data of the survey accumulate, the office organization in separate divisions yields increasing evidence of the advantages thus gained for the work at its outset. It may also be remarked, as incidental to the convergence of details so distinct in character as are those which will be presently brought under notice, that without their allotment into classes the labor spent in their ultimate reduction to the form of charts for public use could hardly be described within the limits of a general report. In the following abstract the duties of each branch of the office will be alluded to as briefly as possible. The divisions are retained as heretofore and will be mentioned in the usual order.

Hydrographic division.—Under all conditions a large share of responsibility necessarily attaches to this branch of the office. The peculiar difficulties which were to be expected during the war were fortunately met by the abilities of Captain C. P. Patterson, who was called to the charge of the division in 1861. His acquaintance with naval routine and intimate knowledge of the local peculiarities of the Atlantic, Gulf, and

Pacific coasts of the United States, have been specially advantageous to the work. To his readiness of mind in consultation, and sound judgment in the arrangement of details, the assistant in charge of the office acknowledges indebtedness for much of the success which has attended the labors of the last four years.

Among the duties discharged by Captain Patterson, who still directs the work done in this important division, are the arrangements and special instructions for the efficiency of hydrographic parties while in service afloat. These include the repairs of vessels, their outfit, and the safety of such of them as may be laid up during winter. In office-work he has been assisted by two draughtsmen since February, only one being attached to the division during the preceding part of the surveying year. The work of both draughtsmen will be recapitulated, to show in brief the relation of the duties of the hydrographic inspector to the work done afloat, and also to that done subsequently in the office. Under the immediate direction of Captain Patterson, Mr. Arthur Balbach has verified the original hydrographic sheets as they have come in from the parties working on the coast. He indicates on the sheets the soundings which are to appear on the reductions, and consequently on the engraved charts, and revises and verifies the reduced drawings before they are engraved. The sheets engraved during the year have been verified in the same way, sailing lines are marked on them in the division, and also the positions of light-houses, beacons, and buoys. Ranges given in the Sailing Directions are tested previous to their adoption by the hydrographic inspector. Special instruction has been given in this branch of the office when necessary to facilitate the operations afloat, and calls have been met for information in regard to hydrographic matters generally. The local reductions needed for the issue of new editions of charts have for the most part been made by this draughtsman. In August, under the personal direction of Captain Patterson, Mr. Balbach thoroughly sounded the Eastern Branch of the Potomac between the navy-yard and Bladensburg.

Mr. Julius Sprandell joined the division in February, and made the projections for a considerable number of the hydrographic sheets of this season, and has plotted the soundings on several from the original journals. During parts of June and July he was on duty with the hydrographic party in the survey of the Cape Fear entrances, and since his last return to the office has been employed in reductions and miscellaneous work. He assisted also in the survey of the Potomac above the navy-yard.

Tidal division.—The correspondence with observers, and the occupation of persons engaged in the office-work of this division, have been continued under the direction of Assistant L. F. Pourtales. His report to the Superintendent (Appendix No. 6) gives the particulars in regard to tidal stations, the names of observers, &c. Only three persons are now attached to the division. Of these Mr. John Downes has during the year continued the reduction of results from readings of the times and heights of tides as recorded by the self-registering tide-gauges. M. Thomas has kept in uniform style for preservation in the archives a record of the readings of the self-registering gauges, and F. R. Pendleton has continued the reduction of observations made on the tides of the western coast.

In order to exemplify with greater clearness the peculiarities of the tides on the western coast, a diagram has been prepared by Assistant Pourtales, and is given with this report as Sketch No. 26. An explanation of the diagram will be found in the Appendix, (No. 11.)

Computing division.—The duties of this division, which remains, as heretofore, in charge of Assistant Charles A. Schott, have been prosecuted with but little variation from the usual routine. The same force is employed, and, as usual, separate notice will be made of the occupation of each computer.

In addition to his general duties as chief of the division, Mr. Schott has given his special attention to the adjustment by the method of least squares of the primary triangulation of the New England coast, performing himself the computations for determining the weight for each direction and establishing the equations of condition. His reports on the resulting length and degree of accuracy of the primary base-lines connected with that work, and on the geodetic connection of those with the base-line on Fire island, are given in the Appendix, with papers communicated by him on other subjects of special importance. Among these is one of much interest on the distribution of magnetism in the United States, illustrated by two charts. Numerous reports on the routine work of the division have been received from him in the course of the year, and, as heretofore, all calls upon him for data needed in other branches of the survey have been promptly met.

For the determination of longitude the results of the reduction of seven hundred and forty-three occultations of the Pleiades have been furnished to Professor Peirce of Harvard, in accordance with arrangements mentioned in preceding reports. The revision of these laborious computations was made personally by Mr. Schott. The computations for the period between 1856 and 1861 were completed within the present year by Assistant T. W. Werner, and check reductions of the same observations were made by Mr. R. S. Avery.

Mr. Eugene Nulty completed the reduction of astronomical and magnetic observations made in West Virginia, Maryland, and Ohio in 1864, computed the table of factors for facilitating transit reductions, and solved several sets of normal equations. He has now in hand the reduction of astronomical and magnetic observations made within the year on the Mississippi, Ohio, and Tennessee rivers

Dr. G. Rumpf prepared the table of geographical positions and the astronomical and geodetic statistics intended for this year's report. He completed the adjustment of Parts II and III of the primary triangulation of the coast of New England, solved two sets of normal equations, and computed the probable errors of the horizontal angles at stations Blue Hill, Copecut, Sandford, Ivy, Wooster, and Tashua. He computed results from the triangulation of the St. Croix river and from that done on the Hudson in 1856, revised that of Narragansett bay and that of Koos bay, and completed office-work on the triangulation made in 1863 of the District of Columbia.

Mr. E. H. Courtenay has performed the clerical duty of the division, duplicated records, converted measures of length, revised and indexed geographical registers, assisted in the preparation of the lists of geographical positions for publication in this report, and aided Mr. Rumpf in the solution of normal equations. He also computed the run of micrometers, prepared abstracts of horizontal angles, and assisted in the miscellaneous work of the division.

Mr. J. G. Spaulding reported for duty on the 9th of December, 1864. In addition to miscellaneous computations not admitting of classification, he adjusted for monthly means the magnetic records of Key West, and computed results from the triangulation of Narragansett bay and from that of the coast of California north and west of Santa Cruz. He also computed the triangulation made in Penobscot bay in 1864, and has nearly completed the reduction for Blue and Union bays from the records of 1863–'64. During August and September Mr. Spaulding was employed in field duty in Section II.

Drawing division.—The duties of this branch of the office have been conducted under the immediate direction of the assistant in charge, J. E. Hilgard, esq., aided by Mr. W. T. Bright. The following synopsis shows the occupation of each draughtsman during the year ending with October:

Assistant M. J. McClery has drawn topography, as far as surveyed, for sheet No. 1 of the Potomac river chart, and added details upon photographs for coast charts Nos. 8, 9, 10, 11, 21, and 54.

He has also filled in the details upon engraved outlines for the coast chart of Wassaw sound and made verifications.

Mr. E. Hergesheimer has adapted the material for photographic reduction in making coast charts Nos. 7, 8, 9, 10, 11, 21, and 53; also for charts of the Kennebec and Sheepscot rivers. Hudson river sheet No. 1, and Eastport harbor, and the details for coast chart No. 6, are now in hand. His drawing includes a map to illustrate Major General Sherman's campaign from Chattanooga to Atlanta, another showing the fortifications at the entrance of Cape Fear river, North Carolina, and the additions of the year to the Congress map. He has arranged the lettering for maps and charts in process of publication, and has made verifications, projections for field parties, and diagrams.

During part of the month of June, Mr. Hergesheimer made a hydrographic survey of the back channel at League island, (Delaware river,) for the Navy Department, and between July 15 and September 26, he was engaged in the topographical survey of part of the Kennebec and Sheepscot rivers, as mentioned under the head of Section I in this report.

Mr. A. Lindenkohl compiled additional material for maps for use in the army until the end of the rebellion, including also a map of the military department of the Gulf and the plan of attack on the Cape Fear defences, ordered by Admiral Porter for the use of his squadron. He has continued the drawing of a chart of Eastport harbor and that of St. George's river and Muscle Ridge channel, and has made additions and corrections on the Atlantic and Gulf sailing charts, as well as on the chart of Chesapeake and Delaware bays, and the general chart in three sheets of the western coast of the United States. The hydrographic resurvey of Boston harbor has been reduced for the harbor chart and for coast chart No. 10, and the drawing of the hydrography of coast chart No. 7 and No. 8, and that of preliminary sea-coast chart No. 3, has been continued. He has also been employed upon diagrams, progress sketches, projections for filed parties, projections on copper, and verifications.

Mr. H. Lindenkohl returned to the office in July, and since that time has reduced topography for a finished map of the southern part of San Francisco bay, and lettered two sheets of topography showing the approaches to Baltimore. He has also assisted in the lithographic division and in miscellaneous work in the drawing division.

Mr. F. Fairfax has added revised material to the chart of Chesapeake and Delaware bays, and has drawn

the topography for charts of Charlotte harbor and Bristol harbor, Rhode Island. He has also reduced additional topography for coast chart No. 108, and the details upon the engraved outline of the chart of St. Helena sound, and has made projections for field parties, and tracings.

Mr. W. B. McMurtrie was employed upon a special chart of Charleston bar for lithographing, in adding details to that of Bodega bay, in drawing the preliminary chart of Sippican harbor, and in plotting hydrographic work, until May, when he was assigned to duty afloat.

Mr. J. H. Logan has been chiefly employed in tracing from topographical sheets for photographic reduction. He has also drawn the topography for a finished chart of Camden and Rockport harbors, and has made miscellaneous tracings.

Messrs. B. Hooe and W. Fairfax have continued upon tracings and miscellaneous duties.

Mr. H. Custer was temporarily attached to this division from December, 1864, to August, 1865, during which time he compiled from the original sheets two maps showing the approaches to Baltimore, for the chief engineer of the middle military department.

Mr. F. Lindenkohl was from December, 1864, until February, 1865, engaged upon tracings.

Mr. E. Willenbucher, since his return from hydrographic duty in Section V, in August, has been employed in plotting hydrographic work and upon special tracings.

A list of the maps, charts, and sketches which were completed or have been in progress during the year, is given in the Appendix (No. 7.)

Engraving division.—This division has remained under the charge of Mr. Edward Wharton since the date of the last report. The clerical duties have been faithfully discharged during that time by Mr. George C. Schaeffer, jr. The engraving force, consisting at present of seventeen engravers of various degrees of skill, has been principally employed as follows:

Mr. John Knight engraved the titles, a portion of the soundings, and most of the general lettering and notes upon coast chart No. 10; additional lettering upon No. 8, and on that of the Kennebec and Sheepscot rivers; the title on coast chart No. 48; the soundings and bottoms on No. 100; the general lettering on No. 54; some additional soundings and lettering upon the chart of the Pacific coast from Point Pinos to Bodega Head, and additions and corrections to the lettering on various plates.

Mr. A. Rollé has completed the engraving of topography upon coast chart No. 27 (bis;) has nearly completed that upon No. 28; has continued the engraving of outlines for No. 7; and outlines and topography upon coast chart No. 9.

Mr. Joseph Enthoffer has continued the engraving, on contract, of the topography upon coast chart No. 21.

Mr. A. Sengteller has completed the engraving of topography upon coast chart No. 53, and the outlines of No. 54, and is well advanced upon the topography of the latter.

Mr. William Phillips completed the engraving of topography upon the plate of Calibogue sound and Skull creek, South Carolina. His employment ceased in April.

Mr. Henry C. Evans has continued the engraving of outlines and topography upon coast chart No. 8, and upon that of the Kennebec and Sheepscot rivers, and the outlines upon coast chart No 11, and has completed the engraving of topography upon the lower sheet of Hudson river.

Mr. H. S. Barnard completed the engraving of sand upon the following plates: coast charts Nos. 69, 70, and 71, the standard plate of Boston harbor, (new edition,) Potomac river sheet No. 2, and the chart of the Pacific coast from Point Pinos to Bodega Head. He engraved some additional sanding upon coast chart No. 40, and additions and corrections in topography upon the three plates of the general chart of the western coast.

Mr. A. M. Maedel completed the engraving of topography upon plate No. 1 of the Potomac river, and has nearly completed that upon plate No. 4.

Mr. J. C. Kondrup engraved additional topography upon coast charts Nos. 40 and 41, additional outlines upon coast charts Nos. 10 and 21, and on that of Delaware and Chesapeake bays. He engraved, also, part of the outlines and topography upon coast chart No. 108, and miscellaneous work upon various plates.

Mr. E. A. Maedel has completed the notes for coast chart No. 69; additional lettering upon plate No. 1 of the Atlantic coast, and on plate No. 3 of the Hudson river, and coast chart No. 28; additional soundings on coast chart No. 41; the title and part of the soundings for coast chart No. 54; a portion of the soundings, &c., for the chart of Eastport harbor, and the title, soundings, notes, and general lettering for that of St. George's river and Muscle Ridge channel, besides additions and corrections upon various other plates.

Mr. A. Petersen completed the lettering upon plate No. 3 of the Hudson river; additional soundings

and lettering upon the standard plate of Boston harbor, and on those of Delaware and Chesapeake bays, coast charts Nos. 40 and 41, and Wassaw sound; the notes upon the plate of Beaufort river and inside passage between Port Royal and St. Helena sounds; all the soundings, title, and general lettering upon plate No. 4 of the Potomac river; corrections in hydrography for sheet No. 3 of the same chart, and a large amount of miscellaneous engraving.

Mr. R. F. Bartle has completed the engraving of topography for the upper sheet of the James river, Virginia, including the Appomattox river to Petersburg, and that of the plate of Barnstable harbor, besides part of the sanding on coast chart No. 8. He was temporarily transferred to the lithographic division in June.

Mr. William A. Thompson has completed the engraving of topography upon the plate of Bodega bay. He engraved a portion of the outlines on those of Boston harbor, Eastport harbor, St. George's river, Maine, Bristol harbor, Rhode Island, and miscellaneous work, and is now engraving the topography of Bristol harbor.

Mr. F. W. Benner engraved a portion of the outlines upon the plate of Beaufort river and inside passage between Port Royal and St. Helena sounds; completed the sanding upon plate No. 3 of the Hudson river, and that of Tomales bay, and engraved a portion of the sanding on the plates of Sippican harbor, coast chart No. 41, and Absecom inlet. He engraved all the topography for the last-named chart, and a large amount of miscellaneous work, and is now engraving the sanding of plate No. 3 of the Potomac river.

Mr. John G. Thompson has completed the engraving of notes and general lettering for the chart of Charlotte harbor. He engraved a portion of the shore-line for that of Eastport harbor, part of the outlines and the notes, title, general lettering and sand for that of Beaufort river and inside passage; additions to the topography of Tomales bay; various corrections in soundings and lettering upon the three plates of the general chart of the western coast, and a large amount of miscellaneous work.

Mr. Edward H. Sipe has engraved the material for a new edition of the chart of Nantucket shoals, and completed the outlines, title, and figures for diagrams No. 38 and No. 40, to accompany the report of the Superintendent for the year 1864. He engraved all the outlines of the chart of Camden and Rockport harbors and miscellaneous additions and corrections to various plates.

Mr. William H. Davis engraved the notes for the chart of Cape Lookout shoals, and the titles, notes, general lettering, &c., for those of Sippican harbor, Absecom inlet, mouths of the Roanoke river and Lighthouse inlet. He engraved additional soundings for the sub-sketch of Portland harbor, and miscellaneous work on progress sketches.

Mr. A. Buckle punched the figures of soundings upon the following plates, viz: chart of the Isles of Shoals, Sippican harbor, Absecom inlet, Wassaw sound, and Beaufort river, including the inside passage between Port Royal and St. Helena sounds. He has also ruled for tint-printing, with the ruling machine, the following chart-plates, viz: Atlantic coast of the United States, in four sheets; the gulf of Mexico, in two sheets; the chart of Nantucket shoals; that of the sea-coast of Delaware, Maryland, and part of Virginia, and two plates showing the navy trial-courses in New York bay and Hampton Roads, in addition to miscellaneous work upon other plates.

In the Appendix (No. 7) a list is given showing which of the plates here mentioned have been completed within the year and which of them are yet in progress.

Electrotype and photograph division.—By the electrotype process twenty-four plates, mostly of the largest class, have been made within the year, under the direction of Mr. George Mathiot, who has been aided since June by Mr. A. F. Pearl.

The photographic work of the division has been continued with complete success in reducing matter from the primary sheets of the survey to the scale proper for publication, and in copying preliminary maps or sketches not intended for engraving. In these operations the plan has been perfected of determining by calculation the focal points for the desired reduction. Thus the time required for adjusting the camera has been lessened, and exactness of size is secured, as well as the greatest degree of sharpness which the lens is capable of producing in the definition of the lines presented for reduction. Sixty negatives have been made within the past year, principally from the plane-table sheets of the survey. These, as explained in previous reports, are supplied to the engravers in parts, as the progress of their work may require. Twenty-two positives have been made for similar purposes.

Lithographing division.—The work in this division, including also the map printing, distribution, &c., has been directed by Mr. W. W. Cooper during the year. No change was made in the arrangements referred to in my last annual report, until the middle of October, when the use of one of the lithographic presses was

dispensed with. The other is still used for printing by transfer from the copperplates of preliminary charts and sketches, of which work the statistics will be given under the head of map printing.

As the war progressed, general maps of the coast and interior were drawn as occasion called for, to embrace the ground of naval and military operations. When the war closed the aggregate of such reductions from the data of the survey alone included the Atlantic coast and its bays, harbors, and river entrances from the vicinity of Cape Henlopen to St. Augustine on a uniform scale of ten miles to the inch; besides one hundred and fifty-five miles of the course of the Mississippi river, embracing two important sites of the naval operations in that quarter, forty-seven miles of the course of the lower Ohio, and the Tennessee river from Paducah to the Muscle shoals, a distance of two hundred and sixty-two miles.

The surveys in the western waters are on a uniform scale of $\frac{1}{40000}$, or rather more than an inch and a half to the mile, and were made for the immediate use of the Mississippi squadron.

The maps here alluded to combine from various sources the best material now known, and their usefulness for general purposes has been fully recognized. About one-half of the entire area represented was mapped during the winter and spring of the present year by Mr. A. Lindenkohl, and engraved on stone by Mr. C. G. Krebs. To assist in the early completion of the maps of the western rivers, Mr. R. F. Bartle was temporarily attached to the division in June, and Mr. E. H. Sipe in October. The engraved map of the Tennessee river, in sixteen sheets, is nearly completed, and that of the Mississippi between Cairo and St. Mary's, in six sheets, is in progress. Under the head of Section VIII in the report of the Superintendent the expression of high naval authority is cited in regard to the value of these maps.

In miscellaneous duties Mr. Krebs has engraved within the year Sketches Nos. 19, 27, 28, 29, and 30, which accompany this report, and all the notes needed in the issue of revised charts by transfer printing; and has adjusted all transfers not made from a single plate.

Map printing.—By the press used for copperplate printing, thirteen thousand six hundred and seventy copies of hydrographic charts have been produced within the year; and by the two lithographic presses, eighteen thousand two hundred and sixty-six copies. This aggregate of about thirty-two thousand sheets is exclusive of nine thousand copies of maps of the coast and interior, printed by transfer from the engraved material referred to under the preceding head. These last represent alone a total of over twenty thousand impressions, more than half of the number of maps stated being in two colors, and more than a third of them in three colors, for the sake of greater distinctness in the water-lines and railroad routes. In several instances the usual hydrographic features of charts have been successfully represented by gradations of tint in printing, and we now look forward to the general use of this cheap and expeditious process.

The copperplate press has been worked by Mr. T. V. Durham since the middle of September. Mr. Archibald Brown has made all the transfers used for printing charts and maps and has steadily worked the large lithographic press. The smaller press was worked by Mr. James Ruhl until the middle of October.

In addition to the map-printing, about eight thousand impressions were made with the small press, for sailing notes, letter-heads, &c.; and over seven hundred proofs were taken on the copperplate press of chart plates in various stages of their progress in engraving. The work here reported shows that an aggregate of above sixty-one thousand impressions has been made with the three office presses during the present year.

Distribution of charts and annual reports.—The map-room has continued under the charge of Mr. M. T. Johnstone, and by his returns it appears that the distribution of charts, though not so great as last year, has been quite large.

Twenty-two thousand five hundred and fifty-six copies of hydrographic charts have been distributed during the year, as follows:

To the navy	9,122
To sea captains and pilots employed in government service	3,351
To military officers	765
For the revenue service, light-house service, and miscellaneous	3,892
By sale	5,426
Total	22,556

Seven thousand nine hundred and sixty-two copies of those issued for the use of the navy, were furnished to the Naval Observatory. Under the head of "miscellaneous" are included copies supplied to agents of the

treasury connected with the customs and internal revenue; presentation copies to foreign ships of war, and to foreign marine boards; copies furnished to members of Congress, and those needed for use in the office.

Masters of vessels continue to resort to the map-room, not only to obtain information, but also to procure the most recent charts of parts of the coast they intend to visit. The accuracy of the charts and their usefulness are made by such persons the subject of frequent commendation; and instances are detailed by them of vessels having been saved from shipwreck during dense fogs by relying on the published soundings. The calls here referred to have steadily increased in number.

The distribution of the printed reports of the Superintendent has been large, and the demand for them is increasing. The edition of that for 1862 is already nearly exhausted. An aggregate of fourteen thousand one hundred and fifty-five copies of all years remains on hand. A table in Appendix No. 7 contains a statement of the distribution of these reports during the year.

Folding-room.—The work of backing with muslin the sheets required by field and hydrographic parties, and the miscellaneous duties pertaining to the folding-room, were performed by Mr. G. W. Francis until March. Among these details were the preparation of complete sets of maps and charts for official use at the Executive Mansion and in the Navy Department, and the preparation of backed drawing paper for the engineer officers engaged in the minute survey at Richmond, Virginia. Since March the work of the room has been done by Mr. E. Wurach.

Archives.—The original sheets of the survey, and the records of observations made by the astronomical and triangulation parties, are duly registered as they come in, and are filed for convenient reference. In the Appendix (No. 8) will be found lists of the topographical and hydrographic sheets arranged in geographical order from the register of the archives. The details here referred to have been in charge of Mr. A. Zumbroch since the 1st of September.

Mr. T. J. Hunt, foreman of the instrument shop, and Mr. A. Yeatman, of the carpentry, have promptly met the requisitions for adjunct work connected with the general operations of the survey.

My thanks are due to the disbursing agent, Samuel Hein, esq., for his care and forethought, on which so much of the success of the work has been of necessity dependent.

The clerical duties of the Superintendent's office, and the direction of work in two of the office divisions, have remained in charge of the principal clerk, W. W. Cooper, esq., whose energetic aid, guided by familiarity with administrative details and practical tact, call for special acknowledgment in this place.

In conclusion, I beg leave to express my profound regret at the impaired state of the Superintendent's health, in consequence of which the duty of preparing this report has devolved upon me.

Respectfully submitted by

J. E. HILGARD,
Assistant in charge of Coast Survey Office.

Hon. HUGH MCCULLOCH,
Secretary of the Treasury.

APPENDIX.

APPENDIX No. 1.

Distribution of the parties of the Coast Survey upon the coasts of the United States during the surveying season of 1864–'65.

Limits of sections.	Parties.	Operations.	Persons conducting operations.	Localities of operations.
SECTION I.				
From Passamaquoddy bay to Point Judith, including the coast of Maine, New Hampshire, Massachusetts and Rhode Island.	No. 1	Topography	W. H. Dennis, sub-assistant; F. D. Granger, aid.	Shore-line survey of Passamaquoddy bay continued, to include the Letite Passage and the entrance of St. Croix river. (See also Section V.)
	2	Topography	Cleveland Rockwell, sub-assistant.	Detailed plane-table survey of the shores of Gouldsborough bay and Prospect harbor, including islands on the coast of Maine between Dyer's bay and Schoodic Point. (See also Section IV.)
	3	Triangulation	G. A. Fairfield, assistant; F. D. Granger, aid.	Triangulation extended eastward, to embrace the upper part of Frenchman's bay, Skilling's river, and adjacent islands on the coast of Maine.
	4	Hydrography	Horace Anderson in charge; L. A. Sengteller, aid; McL. W. Thomson, aid.	Soundings in Penobscot bay, developing the hydrography of the approaches to Rockport and Camden harbors.
	5	Topography	Charles Ferguson, sub-assistant.	Topography of the entrance, completing the survey of the St. George river, Me., and including the islands in the approaches. Plane-table survey of the Medomak river from Waldoboro southward to Sampson's cove.
	6	Topography	F. W. Dorr, sub-assistant; Franklin Platt, aid.	Detailed survey of islands on the coast of Maine, adjacent to Muscongus bay and the mouth of Damariscotta river. (See also Section IV.)
	7	Hydrography	R. E. Halter, sub-assistant, (part of season;) Clarence Fendall, sub-assistant, (part of season;) J. W. Brown, aid.	Soundings in the upper part of Muscongus bay, completing the hydrography of the approaches to the St. George river, Me. (See also Section V.)
	8	Topography	Samuel A. Gilbert, assistant; J. W. Donn, sub-assistant, (part of season.)	Plane-table survey of the upper part of Damariscotta river, including both shores between New Castle and Hodgdon's Mills. (See also Section III.)
	9	Topography	Edwin Hergesheimer........	Supplementary details, completing the topographical survey of Westport, Southport, and Arrowsic islands, forming part of the shore of the Sheepscot river, Me. (See also Section II.)
	10	Topography	R. M. Bache, assistant	Detailed survey of the shores of Kennebec river extended north of Woolwich, Me. (See also Section II.)

APPENDIX No. 1—Continued.

Limits of sections.	Parties.	Operations.	Persons conducting operations.	Localities of operations.
SECTION I—Continued.	No. 11	Topography	A. W. Longfellow, assistant.	Plane-table survey of Sebaskahegan peninsula, Yarmouth island, and part of Orr's island, completing the survey of the shores of Casco bay, Me.
	12	Hydrography	Alexander Strausz, acting assistant; L. L. Nicholson, aid; Charles Hein, aid.	Soundings between Bald Head and the Saddle Rocks; and also north of the Elm islands, completing the hydrography of Quohog bay, Me.
	13	Physical survey	Henry Mitchell, assistant	Service connected with the special survey of Boston harbor for United States commissioners.
	14	Topography and hydrography.	F. W. Dorr, sub-assistant; Franklin Platt, aid.	Shore-line and hydrographic changes developed by a special examination of the entrance to the harbor of Nantucket. (See also Section IV.)
	15	Hydrographic examination.	F. P. Webber, sub-assistant.	Soundings on the "Sow and Pig's reef," to determine the proper site for a light-house at the entrance to Buzzard's bay, Mass.
	16	Topography and hydrography.	A. M. Harrison, assistant; Chas. Hosmer, sub-assistant; F. P. Webber, sub-assistant; A. R. Fauntleroy, H. Anderson, and H. G. Ogden, aids.	Detailed survey of the shores of Narragansett bay continued, embracing the upper part of Newport island, the vicinity of Warren Neck, the western shore of Mt. Hope bay and of Providence river, and Warwick Neck. Special survey, including soundings and tidal observations, in Seekonk river.
	17	Hydrography	F. P. Webber, sub-assistant; A. R. Fauntleroy, H. Anderson, W. W. Harding, and Gershom Bradford, aids.	Hydrography of Narragansett bay, extended from Rose island to Beaver Tail light. Supplementary soundings in Newport harbor; and the hydrography of Providence river from the city wharves up to Rocky Point.
		Inspection	H. L. Whiting, assistant	Inspection of topographical parties in the field in this section.
		Tidal and magnetic observations.	H. W. Richardson, T. E. Ready.	Tidal and magnetic observations continued in the regular series at Portland; and tidal observations at Charlestown navy yard.
SECTION II. From Point Judith to Cape Henlopen, including the coast of Connecticut, New York, New Jersey, Pennsylvania, and part of Delaware.	1	Geodetic, astronomical, and magnetic observations.	A. D. Bache, superintendent; G. W. Dean, assistant; Edward Goodfellow, assistant; A. T. Mosman, sub-assistant; F. F. Nes, sub-assistant; J. G. Spaulding, aid.	Stations West Hills and Ruland, in the primary triangulation, occupied in completing the connection of the Epping base with the Fire Island base. Latitude, azimuth, and the magnetic elements determined at both stations.
	2	Triangulation	Edmund Blunt, assistant; A. T. Mosman, sub-assistant; J. A. Sullivan, sub-assistant.	Triangulation connected with the primary work extended in conjunction with the triangulation of Hudson river. (See also Sections III and VIII.)
	3	Topography	C. M. Bache, assistant	Plane-table survey of the south shore of Raritan bay, supplementary to the topography of New York harbor.
	4	Triangulation	John Farley, assistant	Triangulation of the coast of New Jersey extended southward to the vicinity of Tuckerton.
	5	Topography and hydrography.	R. M. Bache, assistant; Edwin Hergesheimer.	Special and minute plane-table and hydrographic survey of the back channel at League island, in Delaware river, for the Navy Department. (See also Section I.)
		Tidal observations.	R. T. Bassett	Observations continued in the regular series at New York city and Brooklyn.

APPENDIX No. 1—Continued.

Limits of sections.	Parties.	Operations.	Persons conducting operations.	Localities of operations.
SECTION III.				
From Cape Henlopen to Cape Henry, including the coast of part of Delaware, the coast of Maryland, and part of the coast of Virginia.	No. 1	Topography	C. T. Iardella, sub-assistant.	Completion of detailed survey of the environs of Baltimore, and extension to include both shores of the Patapsco below the city.
	2	Triangulation.....	J. A. Sullivan, sub-assistant; C. S. Hein, aid.	Triangulation of Potomac river extended from Georgetown to Harper's Ferry. (See also Section II.)
	3	Topography	J. W. Donn, sub-assistant; H. L. Marindin, aid, (part of season;) McL. W. Thomson, aid, (part of season.)	Detailed survey of the north side and topographical reconnaissance of the south shore of the Potomac river from Great Falls to Harper's Ferry. (See also Section I.)
	4	Reconnaissance ...	J. G. Oltmanns, assistant....	Topographical reconnaissance made in service with the army of the Shenandoah, near Bartonsville, Virginia.
		Tidal observations.	C. Kelly..................	Series of observations continued with the self-registering tide-gauge at Old Point Comfort, Virginia.
SECTION IV.				
From Cape Henry to Cape Fear, including the coast of part of Virginia, and of part of North Carolina.	1	Topography	Cleveland Rockwell, sub-assistant; F. W. Dorr, sub-assistant; W. W. Harding and Franklin Platt, aids.	Plane-table survey of the town and approaches of Goldsborough, North Carolina, for military purposes, and general service in the army movement northward from Savannah, Georgia. (See also Section I.)
	2	Hydrography	Acting Master Robert Platt, U. S. N.; Charles Junken.	Development by soundings of the Cape Lookout shoals, and extension of the in-shore hydrography between Cape Lookout and Cape Fear.
	3	Light-house service	Edward Cordell, acting assistant.	Hydrographic examination of Beaufort harbor, N. C., replacing buoys, and general duties as light-house inspector for the waters of North Carolina. (See also Section X.)
	4	Hydrography	J. S. Bradford, sub-assistant; H. M. De Wees and J. J. Gilbert, aids.	Complete hydrographic resurvey of both entrances to the Cape Fear river, North Carolina, and general service in connection with the North Atlantic blockading squadron.
SECTION V.				
From Cape Fear to St. Mary's river, including part of the coast of North Carolina, and the coast of South Carolina and Georgia.	1	Hydrography	C. O. Boutelle, assistant; Robert Platt, acting master, U. S. N.; Gershom Bradford, L. A. Sengteller, J. A. Guldin, and A. C. Mitchell, aids.	Hydrographic resurvey of Charleston harbor and its approaches, including the bar and Rattlesnake shoals. Reconnaissance in the upper waters of Broad river, South Carolina, and general service in connection with the South Atlantic blockading squadron.
	2	Reconnaissance and topography.	W. H. Dennis, sub-assistant; F. D. Granger, aid.	Special survey showing the location and character of obstructions and torpedoes in Charleston harbor. Topography of the Coosaw river and inside passage between St. Helena sound and Port Royal sound, South Carolina. Reconnaissance between Land's End and Salkehatchie. (See also Section I.)
	3	Triangulation, topography, and hydrography.	R. E. Halter, sub-assistant; J. W. Brown, aid.	Triangulation for the hydrography of Charleston bar and entrance. Triangulation, topography, and hydrography of Broad river above Port Royal sound, including the Whale branch. (See also Section I.)
	4	Topography	W. H. Dennis, sub-assistant; F. D. Granger, aid.	Topographical reconnaissance for military purposes of the approaches to the city of Savannah, and plane-table survey of its defences. (See also Section I.)

APPENDIX No. 1—Continued.

Limits of sections.	Parties.	Operations.	Persons conducting operations.	Localities of operations.
SECTION V—Continued.	No. 5	Topography and hydrography.	Clarence Fendall, sub-assistant; Stehman Forney, aid.	Shore-line survey and hydrography of the Great and Little Ogeechee, Wilmington river, and Vernon river, with other water passages between Wassaw sound and Ossabaw sound, Georgia. (See also Section I.)
		Tidal observations.	E. M. Converse.............	Observations continued with the self-registering tide-gauge at Bay Point, South Carolina.
SECTIONS VI, VII, VIII, and IX.				
From St. Mary's river to the Rio Grande, including the coast of Florida, Alabama, Mississippi, Louisiana, and Texas.	1	Magnetic observations	Samuel Walker..............	Series of magnetic observations, absolute and differential, completed at Key West.
	2	Topography	C. H. Boyd, sub-assistant; C. P. Dillaway, aid.	Topographical survey of Lookout mountain, Tennessee, for military purposes. Extension of the plane-table survey of Chickamauga battle-ground, and general service with the army at Chattanooga.
	3	Reconnaissance ...	F. H. Gerdes, assistant; A. T. Mosman, sub-assistant; T. C. Bowie, sub-assistant; A. R. Fauntleroy, J. B. Adamson, and F. W. Perkins, aids.	Reconnaissance survey and mapping of the Mississippi river between Cairo and St. Mary's, of the lower Ohio, and of the Tennessee river between Paducah and the Muscle shoals, in continuation of general service in connection with the Mississippi squadron. Special surveys of sites for a navy yard on the banks of the Mississippi and Ohio rivers.
SECTION X.				
From the southern boundary on the Pacific coast to the forty-second parallel, including the coast of California.	1	Triangulation	W. E. Greenwell, assistant; Julius Kincheloe, sub-assistant.	Triangulation of the coast of California extended from Point Año Nuevo northward to Half Moon bay.
	2	Topography	A. F. Rodgers, assistant; A. W. Chase, aid.	Detailed plane-table survey of the sea-coast of California extended from Half Moon bay southward.
	3	Hydrography	Edward Cordell, acting assistant.	Off-shore hydrography of the coast of California between Monterey bay and San Francisco entrance. (See also Section IV.)
	4	Hydrography	W. S. Edwards, assistant; J. S. Lawson, assistant.	Special hydrographic survey of Rincon Rock and Blossom Rock in San Francisco harbor. (See also Section XI.)
	5	Triangulation	J. S. Lawson, assistant......	Continuation of work in the triangulation of Suisun bay, California. (See also Section XI.)
		Tidal observations.	A. Cassidy, H. E. Uhrlandt..	Series of tidal observations continued at San Diego and San Francisco with self-registering tide-gauges.
SECTION XI.				
From the 42d parallel to the northwestern boundary of the United States, including the coast of the State of Oregon and the coast of Washington Territory.		Hydrography	J. S. Lawson, assistant......	Extension from previous limits of the hydrography of Koos bay, Oregon. (See also Section X.)
		Tidal observations.	Louis Wilson...............	Series of tidal observations continued with the self-registering gauge at Astoria.

APPENDIX No. 2.

Information furnished from the Coast Survey office, by tracings from original sheets, &c., in reply to special calls, during the year 1864–'65.

Date.		Names.	Data furnished.
1864.			
November	3	Admiral D. D. Porter, U. S. N.	Tracing of hydrographic sheet of Trent's Reach, James river, with sketch of obstructions in same.
	16	Brig. Gen. J. A. Haskin, U. S. A.	Sketch of Potomac river, from Alexandria to Fort Washington.
	19	Engineer office, military department of West Virginia.	Sketch of Fisher's Hill and its defences, and battle-ground of Cedar creek, Va.
	19	Admiral J. A. Dahlgren, U. S. N.	Hydrography near Land's End, Port Royal entrance, S. C.
	19	Major Gen. J. G. Foster, U. S. A.	Hydrography near Land's End, Port Royal entrance, S. C.
	22	Major Gen. W. H. Emory, U. S. A.	Sketch of Fisher's Hill and its defences, and battle-ground of Cedar creek, Va.
	29	General commanding draft rendezvous	Tracing of Hart island, Long Island sound, N. Y.
December	6	Brig. Gen. J. G. Barnard, chief engineer armies in the field.	Tracing of the topography of Appomattox river, from Petersburg to Port Walthall, Va.
	9	Col. W. E. Merrill, chief engineer army of the Cumberland.	Tracing of the topographical survey of Nashville and environs, Tenn.
	14	Brig. Gen. J. G. Barnard, chief engineer armies in the field.	Tracing of the topography of Appomattox river, from Port Walthall to City Point, Va.
	14	Admiral J. A. Dahlgren, U. S. N.	Tracing of the coast topography between Charleston, S. C., and Savannah Ga.
	16	Major Gen. N. P. Banks, U. S. A.	Compiled map of the State of Lousiana.
1865.			
January	25	Brig. Gen. J. G. Barnard, chief engineer armies in the field.	Tracing showing rebel fortifications on Wilmington river, Ga.
February	7	Engineer bureau	Tracing showing rebel fortifications on Wilmington river, Ga.
	3	Navy Department	Tracing of part of Federal Point, showing Fort Fisher, N. C.
	11	Brig. Gen. J. G. Barnard, chief engineer armies in the field.	Tracing of part of Federal Point, showing Fort Fisher, N. C.
March	8	J. B. Ker, esq., deputy solicitor U. S. Court of Claims.	Tracing of Seven-foot Knoll, entrance to Patapsco river, Md.
April	7	Major C. S. Stewart, chief engineer middle military department.	Tracing of the shores of Potomac river, from Berlin to Bolivar Heights, Md.
	12	Col. Hartman Bache, corps of engineers	Hydrography and topography of the Delaware river, from League island to Tinicum.
	25	M. F. Bonzano, light-house inspector, La.	Tracing of the topographical sheets of the Chandeleur island, La.
	25	Brevet Brig. Gen. O. M. Poe, chief engineer military division Mississippi.	Projection for map of southern States on a scale of $\frac{1}{350000}$.
	26	Brig. Gen. J. G. Barnard, chief engineer armies in the field.	Sketch showing fortifications on Sullivan's island, S. C.
May	28	Major C. S. Stewart, chief engineer middle military department.	Tracing of topographical sheets of Potomac river, from Berlin to Mason's island, No. 2.
June	2	Brevet Brig. Gen. O. M. Poe, chief engineer military division Mississippi.	Topography of Chattanooga and vicinity, Tenn.
	7	Major C. S. Stewart, chief engineer middle military department.	Tracing of topographical sheets of the Potomac river, from Whiteville to Rushville.
	19	Brevet Brig. Gen O. M. Poe, chief engineer military division Mississippi.	Tracing of topographical survey of approaches to Goldsborough, N. C.
	23	Bureau of U. S. engineers	Tracing of topographical survey of Willet's Point and vicinity, N. Y
	26	Col. J. N. Macomb, corps U. S. engineers	Tracing of hydrographic and topographical survey of Isles of Shoals, N. H.
	26	Col. J. N. Macomb, corps U. S. engineers	Tracing of coast topography from mouth of Merrimack river to Hampton river, Mass.
July	14	Prof. J. D. Dana	Topography of Cape Henry, Va.

APPENDIX No. 2—Continued.

Date.		Names.	Data furnished.
1865.			
July	21	Major Gen. Q. A. Gillmore, U. S. A.	Sketch of the fortifications on Sullivan's island, S. C.
	24	Bureau of U. S. Engineers	Tracing of hydrographic survey, vicinity of Fort Lafayette, N. Y.
	25	Board of U. S. engineers	Tracing showing the topography of Long island, Boston harbor, Mass.
	27	Navy Department	Copy of survey of channel behind League island, Delaware river.
September	1	Major Gen. Q. A. Gillmore, U. S. A.	Tracing showing northern defences of Charleston, S. C.
	12	Pennsylvania Company for Insurance on Lives, &c.	Tracing of the resurvey of the back channel at League island, Delaware river.
	12	Brevet Major C. N. Turnbull, corps of engineers.	Two compiled maps showing approaches to Baltimore, Md.
	20	Major C. S. Stewart, corps of engineers	Topography of the Upper Potomac river, from Harper's Ferry to Great Falls.
October	13	Brevet Brig. Gen. O. M. Poe, U. S. A.	Tracing showing defences of Savannah, Ga., towards Wassaw sound.
	15	Capt. P. C. Hains, corps of engineers	Tracing showing resurveyed shore-line of New inlet, entrance to Cape Fear river, N. C.
	26	St. Louis Pilot Association	Tracing of reconnaissance of the Mississippi river from Cairo, Ill., to St. Mary's, Mo.

APPENDIX No. 3.

Statistics of field and office work of the United States Coast Survey during the years—

	Previous to 1844.	From 1844 to 1848.	From 1849 to 1853.	From 1854 to 1858.	1859.	1860.	1861.	1862.	1863.	1864.	Total.
Reconnaissance—											
Area, in square miles	9, 642	13, 599	20, 363	9, 918	1, 782	6, 050	585	716	134	347	63, 136
Parties, number of, in each year	4	5	5	7	3	1	1	4	5	3	
Base lines—											
Primary, number of	1	4	2	3							10
Secondary, number of	2	3	19	23	5	2	1	2	1		58
Length of, in miles	19¼	38	49	50	6	1	1	1	1		167
Triangulation—											
Area, in square miles	9, 076	8, 641	13, 445	12, 896	3, 724	4, 773	1, 632	1, 514	567	347	56, 615
Extent of general coast, in miles	570	738	1, 058	1, 389	358	232	173	152		123	4, 793
Extent of shore-line, in miles, including bays, sounds, islands, and rivers	1, 588	3, 498	5, 143	7, 761	2, 092	1, 617	1, 200	1, 061			
Horizontal angle stations occupied	750	615	992	1, 927	344	322	159	168	181	87	5, 545
Geographical positions determined	1, 183	1, 088	1, 712	3, 592	794	681	402	452	371	201	10, 476
Vertical angle stations occupied	15	18	74	111	17	17	10	18	63	1	344
Elevations determined, number of	44	110	209	174	31	44	11	26	78	5	732
Parties, number of, in each year	4	8	14	19	21	21	14	12	12	7	
Astronomical operations—											
Stations occupied for azimuth	9	18	29	14	7	5	2	2			86
Stations occupied for latitude	9	26	55	24	5	6	2	2		11	140
Stations occupied for longitude	1	9	56	10	1	7	2			10	95
Permanent longitude stations		6	20	10	1	1	1	1	1	1	42
Special longitude stations for occultations, &c				63	24	24					111
Parties, number of, in each year	1	3	5	5	5	6	2	2	1	1	
Magnetic stations occupied, number of		86	51	49	18	19	6	6	8	10	253
Parties, number of, in each year		3	3	4	4	7	4	2	4	2	
Topography—											
Area surveyed, square miles	6, 131	2, 514	3, 072	3, 523	657	601	577	424	191	214	17, 904
Length of general coast, in miles	414	699	975	1, 116	224	330	190	259	16	9	4, 232
Length of shore-line, in miles, including rivers, creeks, and ponds	7, 667	5, 586	8, 863	13, 862	2, 669	2, 113	1, 737	1, 240	683	840	45, 260
Length of roads, in miles	11, 734	4, 788	2, 749	4, 660	482	264	1, 232	1, 249	595	706	28, 459
Parties, number of, in each year	6	7	13	18	22	23	17	20		23	
Hydrography—											
Parties, number of, in each year	2	6	10	11	9	9	9	13		9	
Number of miles run while sounding	29, 214	20, 094	39, 468	58, 822	9, 426	9, 438	2, 434	5, 916	6, 397	3, 560	184, 769
Area sounded out, square miles	9, 601	5, 068	11, 431	13, 617	4, 310	1, 651	225	611	725	376	47, 615
Miles run additional, of outside or deep-sea soundings	1, 800	3, 470	5, 497	14, 524	2, 353	2, 375				321	30, 340
Soundings, number of	808, 147	949, 807	1, 495, 954	2, 148, 584	398, 053	373, 251	224, 978	385, 405	269, 700	234, 910	7, 288, 789
Soundings in Gulf Stream for temperature		1, 331	1, 053	1, 217	235	236					4, 072
Tidal stations, permanent		9	21	40	10	11	7	7	7	7	

APPENDIX No. 3—Continued.

	Previous to 1844.	From 1844 to 1848.	From 1849 to 1853.	From 1854 to 1858.	1859.	1860.	1861.	1862.	1863.	1864.	Total.
Hydrography—											
Tidal stations occupied temporarily	127	148	281	370	32	50	27	34	14	24	1, 107
Tidal parties, number of, in each year	2	6	11	13	10	12	7	9	6	24	....
Current stations occupied	....	223	226	381	38	84	44	7	9	....	1, 012
Current parties, number of, in each year	....	4	6	4	2	1	2	1	1	....	....
Specimens of bottom, number of	1, 029	4, 134	4, 302	1, 626	164	188	11	....	....	....	8, 454
Records—											
Triangulation, originals, number of volumes	27	101	208	393	94	120	82	57	52	25	1, 229
Astronomical observations, originals, number of volumes	17	69	220	233	27	35	13	17	3	14	648
Magnetical observations, originals, number of volumes	4	20	26	64	9	13	17	6	18	19	196
Duplicates of the above, number of volumes	27	183	236	632	77	111	103	53	35	24	1, 481
Computations, number of volumes	78	112	294	483	88	115	66	24	46	25	1, 331
Hydrographic soundings and angles, originals, volumes	188	408	906	1, 236	306	194	129	86	171	125	3, 749
Hydrographic soundings and angles, duplicates, volumes	28	33	82	101	19	10	4	2	6	7	292
Tidal and current observations, originals, volumes	127	205	531	693	75	64	39	27	16	52	1, 829
Tidal and current observations, duplicates, volumes	....	206	773	407	57	54	15	16	13	37	1, 578
Sheets from self-registering tide-gauges, number of	....	....	98	549	149	180	118	75	77	84	1, 330
Tidal reductions, number of volumes	....	410	139	378	52	60	46	28	28	38	1, 179
Total number of volumes of records	566	1, 747	3, 415	4, 620	804	775	511	312	388	366	13, 504
Maps and charts—											
Topographical maps, originals	168	104	194	273	45	47	33	44	23	42	973
Hydrographic charts, originals	142	74	195	263	41	37	16	32	35	37	872
Reductions from original sheets, number of	15	70	149	177	92	23	21	19	19	17	602
Total number of manuscript maps and charts	325	248	538	713	178	107	70	95	....	96	2, 370
Number of sketches made in field and office	311	166	533	617	353	108	62	65	71	60	2, 346
Engraving and printing—											
Engraved plates of finished charts, number of	5	19	23	25	8	8	9	6	6	2	111
Engraved plates of preliminary charts, sketches and diagrams for the Coast Survey reports, number of	....	16	113	215	21	17	14	8	12	19	435
Electrotype plates made in each year	....	8	117	370	87	58	43	43	28	31	785
Finished charts published in each year	....	24	22	24	6	7	7	6	6	2	....
Preliminary charts and hydrographic sketches published	....	8	103	169	15	15	31	34	15	25	....
Printed sheets of maps and charts distributed	....	6, 320	21, 664	42, 801	10, 486	4, 092	13, 094	36, 273	25, 659	31, 320	191, 709
Printed sheets of ditto deposited with sale agents	....	12, 563	21, 030	11, 072	3, 584	2, 145	733	4, 448	3, 615	4, 029	63, 219
Library—Number of volumes	....	655	1, 462	1, 016	174	159	163	91	136	149	4, 005
Instruments—Cost of	....	....	$26, 712	$19, 138	$1, 852	$1, 729	$2, 522	$894 93	$1, 832 87	$694, 63	$55, 374 63

GENERAL NOTE.

Parties.—An average number is given for the years previous to 1844. A party operating in more than one section during the year is counted but once.

Triangulation.—The extent of general coast is measured in general outline, including Delaware and Chesapeake, as well as all open bays, but omitting the minor indentations of the sea-coast. The extent of shore-line is also measured in general outline, and includes such rivers only as have been triangulated.

Topography.—The length of general coast is measured similarly to that under triangulation; but the shore line under topography represents the whole water-line surveyed, including all the minor indentations, as represented on the plane-table sheets.

Records.—The total number of volumes of records given in the table is greater than the number now on hand, owing to the binding up of separate volumes.

Engraved plates.—Progress sketches (averaging fourteen yearly) are not counted.

Library.—The number of volumes purchased and donated up to 1849 was 655.

It is to be remarked that the numbers appearing in the column of this table for the year immediately preceding that of its compilation are, in some cases, subject to be changed, more or less, in the succeeding report, owing to data not being, at the time of compilation, fully turned into the office from the distant parties in the field.

APPENDIX No. 4.

EXTRACT FROM A REPORT BY MR. CHARLES JUNKEN, UNITED STATES COAST SURVEY, ON THE HYDROGRAPHIC DEVELOPMENT OF THE CAPE LOOKOUT SHOALS, NORTH CAROLINA.

The most prominent of the shoals is Lookout breaker, (Cape Lookout light bearing N. by W. seven nautical miles distant,) with only four feet of water on it; and although very heavy breakers, they are no great obstacle to the cautious mariner, their continuous foaming and roar serving to warn in the approach to them. They serve to define the slue, or channel, of two and a half miles in width, between the Lookout breaker and the Shore breaker. This channel is used by coasting vessels drawing less than nine feet. In coming from eastward they head on a west course for the southeast end of Lookout breaker, approach it to within a quarter of a mile, and then steer N.NW. along the breaker until they reach a depth of six fathoms. The Shore breaker also can be followed as a guide through the slue, but no channel available for larger vessels than the class named exists at present, by reason of the many shoal lumps found in the slue.

That part of the shoals which is continuous with the spit extends three miles outside of Lookout breaker, Cape Lookout light then bearing N. by W. ¼ W., and being distant ten and a quarter nautical miles. Here the three narrow ridges connecting with Lookout breaker end, with a depth on them varying between twelve and a half and twenty feet. These ridges are the most dangerous part of the shoals, as there is no indication of their existence in moderate weather.

Beyond the ridges there are three detached lumps, each covering an area of less than half a square mile. The least depths on them are four and three-quarters and five and a half fathoms, and from the outer one Cape Lookout light bears NW. by W. ½ W., distant thirteen and a half nautical miles.

APPENDIX No. 5.

EXTRACTS FROM A REPORT BY SUB-ASSISTANT J. S. BRADFORD, SHOWING THE NATURE OF HYDROGRAPHIC CHANGES AT THE ENTRANCES OF CAPE FEAR RIVER, NORTH CAROLINA.

UNITED STATES STEAMER HETZEL,
Newbern, North Carolina, October 1, 1865.

SIR: * * * * * * * *

The hydrographic examination of the western entrance develops but little change in that bar, except the narrowing of the bulkhead which crosses the old Smith's Island channel, and this may result in the formation of a bar to the eastward of the Middle Ground. The rip near Fort Caswell has shoaled since the former survey, six to six and a half feet being the best water on it at low tide. No other changes were noticed of any importance.

The bar at New inlet has entirely changed. Indeed, alterations were perceptible during the period employed in the survey. This bar was buoyed by order of Admiral Porter on the 16th and 17th of January, but on my return early in June the channel was found shifted very much to the northward. In July and August the point of Caroline shoal was perceptibly encroaching on the sailing line over the bar, and Federal Point shoal was being rapidly cut away, showing that the channel was still working to the northward.

At an early day a new channel will probably be formed across the position of the old bar as it was laid down on the Coast Survey chart of 1858, as there are breakers there only at low water, and heavy breakers only in bad weather. Lines run across that place, however, show no increased depth at present, but merely a banking up of the shoal on either side of it.

Great changes also have occurred in the shore-line of Federal Point, Zeek's island, and Smith's island. The breach of 1857 in Smith's island, however, has disappeared. The changes referred to are quite sensible from month to month, and they are constantly going on.

* * * * * * * *

I am, sir, very respectfully, your obedient servant,

J. S. BRADFORD,
Sub-Assistant, Commanding Hydrographic Party.

Prof. A. D. BACHE,
Superintendent United States Coast Survey, Washington, D. C.

APPENDIX No. 6.

REPORT TO THE SUPERINTENDENT BY ASSISTANT L. F. POURTALES, IN CHARGE OF FIELD AND OFFICE WORK RELATING TO TIDAL OBSERVATIONS.

COAST SURVEY OFFICE, *October* 1, 1865.

SIR: I have the honor to submit the following report on the field and office work performed by the tidal party under my charge during the past year:

Field-work.—The following permanent tidal stations have been continued uninterrupted during the past year: Portland, Maine; Boston, Massachusetts; Governor's island, New York; Old Point Comfort, Virginia; San Diego and San Francisco, California, and Astoria, Oregon. The permanent tidal station which it was intended to establish at Port Royal, South Carolina, was transferred from the Bay Point wharf, where it was not sufficiently sheltered, to another point in the neighborhood selected by Assistant C. O. Boutelle. The starting of the self-registering tide-gauge was much delayed by the necessity of constructing a plank causeway to reach the station across the marsh. In the mean time observations were made on an ordinary gauge until August 30, when the self-registering gauge was finally started.

The tide-gauges on the western coast have been, as heretofore, under the efficient supervision of Captain G. H. Eliot, of the corps of engineers.

The following table gives a recapitulation of the tidal observations received during the past year, exclusive of those taken by the hydrographical parties for the reduction of their soundings. Meteorological observations are made regularly at the stations, except, for the present, at Port Royal.

Section.	Station.	Observer.	Kind of gauge.	Station, permanent or temporary.	Time of occupation.		Total days.	Remarks.
					From—	To—		
I.	Portland, Me	H. W. Richardson.	S. R.	Perm't.	Oct. 1, 1864.	Sept. 30, 1865.	365	
I.	Boston dry dock, Mass	T. E. Ready	Box	Perm't.	Oct. 1, 1864.	Sept. 30, 1865.	365	
II.	Governor's island, N. Y	R. T. Bassett	S. R.	Perm't.	Oct. 1, 1864.	Sept. 30, 1865.	365	
II.	Brooklyn, N. Y	R. T. Bassett	Box	Perm't.	Oct. 1, 1864.	Sept. 30, 1865.	365	Day tides for comparison.
III.	Old Point Comfort, Va	C. Kelly	S. R.	Perm't.	Oct. 1, 1864.	Sept. 30, 1865.	365	
V.	Port Royal, S. C	E. M. Converse	Box	....	Aug. 24, 1864.	Aug. 18, 1865.	325	
V.	Port Royal, S. C	E. M. Converse	S. R.	Perm't.	Aug. 20, 1864.	Sept. 23, 1865.	34	
X.	San Diego, Cal	A. Cassidy	S. R.	Perm't.	Oct. 1, 1864.	Sept. 30, 1865.	365	
X.	San Francisco, Cal	H. E. Uhrlandt	S. R.	Perm't.	Oct. 1, 1864.	Sept. 30, 1865.	365	
XI.	Astoria, Oregon	L. Wilson	S. R.	Perm't.	Oct. 1, 1864.	Sept. 30, 1865.	365	

Office-work.—The following persons have been engaged in computations relating to tides during the past year:

Mr. John Downes has read off and tabulated the sheets of the self-registering tide-gauges, and reduced the results, besides other miscellaneous computations.

M. Thomes has been chiefly engaged in copying and computing the records for final preservation.

F. R. Pendleton has made the first and second reductions of the tidal observations of the western coast.

Very respectfully, your obedient servant,

L. F. POURTALES,
Assistant United States Coast Survey, in charge of Tidal Division.

Prof. A. D. BACHE, LL.D.,
Superintendent United States Coast Survey.

APPENDIX No. 7.

List of maps, preliminary charts, and sketches worked upon in the drawing and engraving divisions during the year ending November 1, 1865, *geographically arranged.*

Names.	Scale.	Description.	Drawing.	Engraving.
SECTION I.				
Sailing chart, Atlantic coast of the United States, Cape Sable to Sandy Hook	1-1200,000	Preliminary chart	Additions	
Preliminary sea-coast chart, No. 3, Cape Small Point, Me., to Cape Cod, Mass	1-1200,000	do	do	
Coast chart, No. 6, Isle-au-Haut bay to Muscongus bay, Me	1-80,000	Finished chart	In progress	In progress.
Coast chart, No. 7, Muscongus bay to Portland harbor, Me	1-80,000	do	do	Do.
Coast chart, No. 8, Seguin island light to Kennebunkport, Me	1-80,000	do	do	Do.
Coast chart, No. 9, Cape Neddick, Me., to Cape Ann, Mass	1-80,000	do	do	Do.
Coast chart, No. 10, Cape Ann to Plymouth harbor, Mass	1-80,000	do	do	Do.
Coast chart, No. 11, Plymouth harbor to Hyannis harbor, Mass	1-80,000	do	do	Do.
Eastport harbor, Me	1-40,000	Preliminary chart	do	Do.
Camden and Rockport harbors, Me	1-20,000		do	Do.
St. George's river and Muscle Ridge channel, Me	1-40,000	Preliminary chart	do	Do.
Kennebec and Sheepscot rivers, Me	1-40,000	Finished chart	do	Do.
Isle of Shoals, N. H	1-20,000	do	Completed	Do.
Lynn harbor, Mass., (new edition of hydrography)	1-20,000	do	do	
Boston harbor, Mass., (new edition)	1-40,000	do	In progress	
Barnstable harbor, Mass	1-20,000	do		Completed.
Sippican harbor, Mass	1-20,000	Preliminary chart	Completed	Do.
Bristol harbor, Narragansett bay, R. I	1-20,000	Finished chart	do	In progress.
Newport harbor, Narragansett bay, R. I	1-20,000	Preliminary chart	do	Do.
Three sketches, showing progress of survey			Additions	Additions.
SECTION II.				
Coast chart, No. 21, New York bay and harbor	1-80,000	Finished map	Completed	In progress.
Hudson river, No. 1, New York to Haverstraw	1-60,000	do	do	Completed.
Hudson river, No. 3, Poughkeepsie to Glasco	1-40,000	Preliminary chart		Do.
Hudson river, No. 4, Glasco to Troy	1-40,000	do		Do.
Absecom inlet, N. J	1-20,000	Finished map	Completed	Do.
Sketch showing progress of survey			Additions	
SECTION III.				
Chesapeake and Delaware bays, (new edition)	1-400,000	Preliminary chart	Completed	
Coast chart, No. 27, Cape May to Fenwick's island light	1-80,000	Finished chart		In progress.
Coast chart, No. 28, Isle of Wight to Chincoteague inlet	1-80,000	do		Do.
Coast chart, No. 31, Chesapeake bay, from head of bay to Magothy river	1-80,000	do		Completed.
Approaches to Baltimore, Md	1-10,000	For military purposes	Completed	
Potomac river, Sheet No. 1, entrance to Piney Point	1-60,000	Preliminary chart	do	Completed.
Potomac river, Sheet No. 2, Piney Point to Lower Cedar Point	1-60,000	do		Do.
Potomac river, Sheet No. 3, Lower Cedar Point to Indian Head	1-60,000	do		Do.
Potomac river, Sheet No. 4, Indian Head to Georgetown	1-40,000	do		In progress.
James river, Richmond to City Point	1-40,000	Finished chart		Completed.
Map of Virginia, (for military use)		For engraving on stone	Additions	
Sketch showing progress of survey			do	
SECTION IV.				
Coast chart, No. 40, Albemarle sound, (western part)	1-80,000	Finished chart		Additions.
Coast chart, No. 41, Albemarle sound, (eastern part)	1-80,000	do		Do.
Coast chart, No. 48, Cape Fear and approaches	1-80,000	do		In progress.
Mouths of Roanoke river, N. C	1-30,000	Sketch		Completed.
Core sound, N. C	1-40,000	Preliminary chart	Completed	
Fort Fisher, (order of attack)		For engraving on stone	do	

APPENDIX No. 7—Continued.

Names.	Scale.	Description.	Drawing.	Engraving.
SECTION V.				
Coast chart, No. 53, Stono inlet to Tripp's inlet, S. C.	1-80,000	Finished chart	In progress	In progress.
Coast chart, No. 54, Tripp's inlet to Ossabaw sound, Ga	1-80,000	do	do	Do.
Charleston harbor, showing rebel defences and obstructions	1-30,000	For engraving on stone	Completed	
Light-house inlet, S. C	1-20,000	Sketch		Completed.
St. Helena sound, S. C	1-40,000	Finished map	Completed	
Beaufort river and inside passage between Port Royal and St. Helena sounds	1-40,000	Preliminary chart		Do.
Calibogue sound and Skull creek	1-40,000	Finished map		Do.
Wassaw sound, Ga	1-40,000	do	In progress	
Sketch showing progress of survey			Additions	
SECTION VI.				
Coast chart, No. 69, Florida reefs, from the Elbow to Matecumbe key	1-80,000	Finished chart		Completed.
Coast chart, No. 70, Florida reefs, from Long key to Newfound Harbor key	1-80,000	do		Do.
Charlotte harbor, Fla	1-40,000	Preliminary chart	Completed	
SECTIONS VIII and IX.				
Coast chart, No. 100, Point-au-Fer to Côte Blanche.	1-80,000	Finished chart		In progress.
Coast chart, No. 108, Matagorda and Lavaca bays	1-80,000	do	In progress	Do.
SECTIONS X and XI.				
General chart of the western coast from San Diego to San Francisco	1-1200,000	Preliminary chart	Additions	Additions.
General chart of the western coast from San Francisco to Umpqua river	1-1200,000	do	do	Do.
General chart of the western coast from Umpqua river to Fuca straits	1-1200,000	do	do	Do.
Pacific coast from Point Pinos to Bodega Head	1-1200,000	do	do	Do.
San Francisco bay, (upper part)	1-50,000	do	In progress	
Bodega bay, Cal	1-30,000	Finished chart		Completed.
MISCELLANEOUS.				
Sketch showing progress of coast survey	1-5000,000	Sketch		Additions.
Diagram illustrating magnetic and meteorological observations at Girard College, Philadelphia		Diagram		Completed.
Diagram illustrating tidal observations at Papeete, island of Tahiti		do		Do.

Distribution made during the year of reports of the United States Coast Survey for the years 1851, 1852, 1853, 1854, 1855, 1856, 1857, 1858, 1859, 1860, 1861, ***and*** 1862.

Names of States, &c.	Report of 1851.		Report of 1852.		Report of 1853.		Report of 1854.		Report of 1855.		Report of 1856.		Report of 1857.		Report of 1858.		Report of 1859.		Report of 1860.		Report of 1861.		Report of 1862.		Total number distributed.
	Individuals.	I[illegible]ons.	Individuals.	Institutions.	Individuals.	Institutions.	Individuals.	Institutions.	Individuals.	Institutions.	Individuals.	Institutions.	Individuals.	Institutions.	Individuals.	Institutions.	Individuals.	Institutions.	Individuals.	Institutions.	Individuals.	Institutions.	Individuals.	Institutions.	
Maine			2		1		1						1		2		3		14		30		127	9	190
New Hampshire																	1		1		1		79	15	97
Vermont															1		2		2		2		33	15	55
Massachusetts					1						1				4		6		16		36		326	35	425
Rhode Island					1						1		1		1		2		4		3		67	22	102
Connecticut	1		1		3						2		1		1		3		5		4		170	13	204
New York	2	1	2	1	9	1	2	1	3	1	9	1	4	1	3	1	14	1	21	1	27	1	588	95	790
New Jersey															1		2		3		12		109	14	141
Pennsylvania					1						1						4		5		11		355	115	492
Delaware																					1		12	3	16
Maryland					3										1		1		6		5		100	17	133
District of Columbia					1						1						1		1		9		81	3	97
Virginia																			1		2		5		8
North Carolina																							1		1
South Carolina																	1		1		1		2		5
Georgia																							1		1
Ohio				1	1	1	1	1						1	1	1	2	1	2	1	4	1	232	75	326
Indiana																							119	28	147
Illinois					1						1						1		1		3		112	25	144
Kentucky																			1		1		5		7
Michigan			1		3		2				1		1		2		2		1		1		71	24	109
Wisconsin																							41	11	52
Minnesota																					1		18	13	32
Iowa																							48	15	63
Kansas																							3		3
California		2		2		1		2		2		2		2		2		2	1	2		2	17	7	46
Oregon																							3	1	4
Nebraska Territory																							1		1
Washington Territory																							2		2
Members of Congress			1		1		1		1		1		1		1										7
Officers of the navy																					3		2		5
Officers of the army																					2		8		10
Ex cutive departments																			2		2		112		116
Coast Survey office			1		2		1		1		1		1		1		1						2		11
Foreign	1		1		1		1		1		1		1		4		2		2		3		374		392
Total	4	3	9	4	29	3	9	4	6	3	20	3	11	4	23	4	48	4	90	4	164	4	3,226	555	4,234
Copies remaining on hand	179		670		1,521		828		334		1,410		256		471		2,171		3,004		2,702		577		....

APPENDIX No. 8.

List of original topographical sheets registered in the archives of the United States Coast Survey, geographically arranged.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST.					
Eastport and vicinity	Maine	1-10,000	....	W. H. Dennis	979
Frenchman's bay, east side, from Wankeag Neck to Winter harbor, including Stave, Jordan, Iron Sound, and Calf islands.	....do	1-10,000	1862	C. Rockwell	891
Baker's island	....do	1-2,500	1854	W. E. Greenwell	463
Camden and Rockport harbors	....do	1-10,000	1863	F. W. Dorr	930
Rockland and Rockland harbor, Penobscot bay.	....do	1-10,000	1861	C. Ferguson	843
South Thomaston, Weskeag river, &c., Penobscot bay.	....do	1-10,000	1861	......do	844
The Matinicus group of islands	....do	1-20,000	1864	F. W. Dorr	958
The Green islands, off the mouth of Penobscot bay.	....do	1-20,000	1864	......do	959
Muscle Ridge islands, Penobscot bay	....do	1-10,000	1862	C. Ferguson	877
Seal, Tennant's, and Mosquito harbors, Penobscot bay.	....do	1-10,000	1862	......do	904
St. George's river, from Narrows to Thomaston.	....do	1-10,000	1863	......do	915
St. George's river, from entrance to Narrows.	....do	1-10,000	1864	......do	957
Medomak river, upper part	....do	1-10,000	1865	......do	984
The western entrance to Penobscot bay, including the St. George's islands, Mohegan and Matinicus.	....do	1-20,000	1865	F. W. Dorr	960
Sheepscot river	....do	1-10,000	1865	R. E. McMath	954
Part of Sheepscot river and vicinity	....do	1-10,000	1859	W. H. Dennis	845
Sheepscot, Back, and Ovenmouth rivers	....do	1-10,000	1859	R. E. McMath	953
Sheepscot and Back rivers	....do	1-10,000	1860	H. Adams, C. Ferguson	801
Back river and Montseag bay	....do	1-10,000	1860-'61	C. Ferguson	802
Hoackomoak bay and islands south of Phipp's Point, Back river.	....do	1-10,000	1861	H. Adams, O. Hinrichs	842
Damariscotta river, (upper part)	....do	1-10,000	1865	S. A. Gilbert	994
Damariscotta river, (lower part)	....do	1-10,000	1865	......do	995
Booth Bay harbor and vicinity	....do	1-10,000	1864	P. C. F. West	961
Westport and Arrowsic islands, (part of)	....do	1-10,000	1865	E. Hergesheimer	982
Kennebec river, (vicinity of Bath)	....do	1-10,000	1858	R. M. Bache	728
Kennebec river, from Bath to Jones's Eddy.	....do	1-10,000	1857	W. S. Gilbert	667
Georgetown islands and vicinity	....do	1-10,000	1862	C. T. Iardella	889
Kennebec river, from Indian Point to Cox's Head.	....do	1-10,000	1857	W. S. Gilbert	666
Cape Small Point and adjacent islands	....do	1-10,000	1854-'57	S. A. Gilbert, C. T. Iardella	465
Kennebec river approaches	....do	1-10,000	1856	J. Hull Adams	588
Kennebec river entrance and Cape Small Point.	....do	1-10,000	1856	......do	587
Peninsula formed by the confluence of the Kennebec and Androscoggin.	....do	1-10,000	1864	R. M. Bache	967
Mouth of New Meadows river	....do	1-10,000	1857	C. T. Iardella	655
Ragged island and adjacent islands near Cape Small Point.	....do	1-10,000	1854-'57	S. A. Gilbert, C. T. Iardella	466
Maquoit and Middle bays, with adjacent shores of Freeport, Brunswick, and Harpswell Neck.	....do	1-10,000	1863	A. W. Longfellow	923

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
Yarmouth and Freeport	Maine	1-10,000		A. W. Longfellow	918
Part of Harpswell Neck, with the adjacent islands in Casco bay.	do	1-10,000	1860-'61	do	847
Casco bay, outer islands	do	1-10,000	1856-'58	do	757
Presumpscot river, mouth of, and islands in Casco bay.	do	1-10,000	1855-'59	do	755
Casco bay, the Green islands	do	1-10,000	1856	do	756
Great Jebeig, Cousins and Little John's islands, with smaller islands, and part of the main shore.	do	1-10,000	1864	do	919
Portland harbor and environs	do	1-10,000	1854-'58	do	735
Portland harbor, reconnaissance of the environs of, and approaches to.	do	1-20,000	1862	F. W. Dorr	878
Part of Cape Elizabeth	do	1-10,000	1852	A. W. Longfellow	414
Richmond's island	do	1-10,000	1850	do	312
Saco bay, north shore, including Stratten and Bluff islands and Prout's Neck.	do	1-10,000	1859	C. Fendall	759
Fletcher's Neck and vicinity	do	1-10,000	1859	do	760
Cape Porpoise and vicinity	do	1-10,000	1859	do	761
Cape Neddick and Ogunquit	do	1-10,000	1854	A. S. Wadsworth	459
York and Cape Neddick harbors, with intermediate coast.	do	1-10,000	1853	A. W. Longfellow	440
Isles of Shoals	New Hampshire	1-10,000	1859	C. Fendall	762
From Hampton river to East Salisbury	do	1-10,000	1855	H. L. Whiting	835
Newburyport and the mouth of Merrimac river.	Massachusetts	1-10,000	1852	A. W. Longfellow	355
Rowley river and part of Plum island to Newburyport.	do	1-10,000	1854	H. L. Whiting, J. H. Adams	559
Ipswich, (unfinished)	do	1-10,000		H. L. Whiting	467
Cape Ann, northern shore, including Essex river.	do	1-10,000	1855	do	556
Annisquam harbor and vicinity, Cape Ann	do	1-10,000	1852	H. L. Whiting, R M. Bache	396
Rockport, extremity of Cape Ann, from Milk island to Lane's cove.	do	1-10,000	1851	H. L. Whiting	341
Gloucester harbor and vicinity, Cape Ann	do	1-10,000	1851	H. L. Whiting, R. M. Bache	397
Salem harbor, from Beverly farms to Kettle cove, (Manchester.)	do	1-10,000	1851	H. L. Whiting	340
South shore of Cape Ann from Danvers new mills to Beverly farms.	do	1-10,000	1851	do	304
Salem harbor, including the city and islands	do	1-10,000	1851	do	303
From Saugus river to Marblehead, northwest shore of Massachusetts bay.	do	1-10,000	1849-'50	do	305
Nahant Neck and Tinker's island	do	1-10,000	1847	do	235
From Point Shirley to Point Pines and Winnissimet village.	do	1-10,000	1847	do	234
Governor island and Castle island, Boston harbor.	do	1-5,000	1846	do	231
Thompson's island, outer Brewster, and intermediate islands, Boston harbor.	do	1-10,000	1847-'49	J. S. Williams, H. L. Whiting.	238
Cities of Boston and Charlestown	do	1-5,000	1846-'47	H. L. Whiting	229
East and South Boston	do	1-5,000	1846-'47	do	230
From Neponset to Roxbury, (interior)	do	1-10,000	1847	do	232
From Roxbury to Malden, (interior)	do	1-10,000	1847	do	233
From Milton Mills to Hingham, southern shore of Boston bay.	do	1-10,000	1847	J. B. Glück	227

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
From Nantasket Hill to Green Hill, Boston bay.	Massachusetts ..	1-10,000	1847	J. S. Williams	237
From World's End Hill to Cohasset harbor, Boston bay.	....do..........	1-10,000	1847	J. B. Glück.............	228
From Cohasset harbor to Scituate harbor, eastern shore.	....do..........	1-10,000	1847	H. L. Whiting, S. A. Gilbert.	236
Part of Boston harbor, including the outer and Brewster islands.	....do..........	1-5,000	1860	H. L. Whiting	830
Part of Boston harbor, including Gallop's, Lovell's, George's, Light-house, and Great Brewster islands.	....do..........	1-5,000	1860	......do................	831
Part of Boston harbor, including Long and Deer islands and Point Shirley.	....do..........	1-5,000	1860	......do................	833
Part of Boston harbor, including Thompson's and Spectacle islands, Moonhead and Squantum.	....do..........	1-5,000	1860	......do................	832
Part of Boston harbor, including Rainsford and Pettick's islands, and Nantasket.	....do..........	1-5,000	1860	......do................	829
North river................................	....do..........	1-10,000	1858	A. M. Harrison	719
Back river and vicinity near Plymouth.....	....do..........	1-10,000	1856-'57	R.M Bache,A.M.Harrison	612
Kingston to Duxbury beach	....do..........	1-10,000	1853-'54	S. A. Gilbert, R. M. Bache	425
Plymouth harbor and vicinity	....do..........	1-10,000	1853	S. A. Gilbert............	455
Wellfleet harbor, Cape Cod peninsula......	....do..........	1-10,000	1851	J. B. Glück.............	368
Cape Cod peninsula, from Billingsgate light to Pamet river.	....do..........	1-10,000	1848	H. L. Whiting	259
Northern part of Cape Cod and Provincetown harbor.	....do..........	1-10,000	....	......do................	616
From Highland to Nansette light	....do..........	1-10,000	1848	......do................	260
From Nansette light to Orleans............	....do..........	1-10,000	1856	C. T. Iardella...........	579
Cape Cod, part of, from Sandy Neck, near Barnstable, to West Sandwich.	....do..........	1-10,000	1860-'61	A. M. Harrison	901
Barnstable harbor and vicinity	....do..........	1-10,000	1859	......do................	795
Southern extremity of Cape Cod...........	....do..........	1-10,000	....	J. B. Glück.............	441
Monomoy island	....do..........	1-20,000	1853-'56	S. A. Gilbert, C.T. Iardella	424
From Bass river eastward.................	....do..........	1-10,000	....	J. B. Glück	402
From Bass river to Hyannis, including West Yarmouth and South Dennis.	....do..........	1-10,000	1855	H. L. Whiting, J. A. Sullivan.	553
Part of South Yarmouth, Barnstable county.	....do..........	1-10,000	1852	A. W. Longfellow.......	356
From West Yarmouth to Hyannis Point....	....do..........	1-10,000	1846	W. M. Boyce	290
From Hyannis Point to Succonnesset	....do..........	1-10,000	1846	......do................	318
From Succonnesset Point to Falmouth Spire.	....do..........	1-10,000	1846	......do................	289
Eastern part of Nantucket, Great Point to Siasconsett.	....do..........	1-10,000	....	H. L. Whiting, W. E. Greenwell.	206
Western part of Nantucket, including Tuckanuck and Muskeget islands.	....do..........	1-10,000	1846	H. L. Whiting..........	205
Martha's Vineyard, eastern part, from Cape Poge to East Chop.	....do..........	1-10,000	1846	......do................	204
Northern shore of Martha's Vineyard, from East Chop to Menemsha Bight.	....do..........	1-10,000	1846	H. L. Whiting..........	203
Southern shore of Martha's Vineyard, from Sampson's Hill to East Edgartown harbor.	....do..........	1-10,000	1846-'56	......do................	202
Gay Head, part of Martha's Vineyard, and No Man's Land.	....do..........	1-10,000	1845-'53	W.M. Boyce, H. L. Whiting.	362
Cuttyhunk island, with Sow and Pig shoal.	....do..........	1-5,000	1853	H. L. Whiting..........	437

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
From Falmouth to Back river, eastern shore of Buzzard's bay.	Massachusetts..	1-10,000	1845	W. M. Boyce	191
Elizabeth islands	....do	1-10,000	1845	......do	192
From Great Hill Neck to Sconticut Neck, western shore of Buzzard's bay.	....do	1-10,000	1845	H. L. Whiting	196
From Back river to Great Hill Neck, northern part of Buzzard's bay.	....do	1-10,000	1845	......do	195
From Sconticut Neck to Clark's Neck, including New Bedford.	....do	1-10,000	1845	......do	194
From Clark's Point to Mishaum, (missing)..	....do	1-10,000	1845	......do	193
From Mishaum Point to Saughkonnet Point.	....do	1-10,000	1844	W. M. Boyce	183
Fall river, part of	....do	1-10,000	1861	A. M. Harrison	885
Mount Hope bay, including parts of Taunton, Lee, and Cole rivers.	Mass. and R. I..	1-10,000	1861	A. M. Harrison, P. C. F. West.	886
Seekonk river	Rhode Island...	1-10,000	1865	A. M. Harrison	978
Shore-line of the western side of the western passage of Narraganset bay.	....do	1-10,000	1863	......do	911
Part of the western shore of Narraganset bay, including Greenwich bay and Hope island.	....do	1-10,000	1863	......do	912
Part of shore-line of Narraganset bay and Providence river.	....do	1-10,000	1863	......do	913
Shore-line of part of Providence river	....do	1-10,000	1863	......do	914
Mount Hope bay, part of	....do	1-10,000	1861	......do	884
Mount Hope and Bristol bays, part of	....do	1-10,000	1862	......do	888
Bristol Neck	....do	1-10,000	1864	A.M.Harrison, C.Hosmer.	956
Prudence island, Narraganset bay	....do	1-10,000	1862	A. M. Harrison	887
Part of the west shore of the island of Rhode island, from Coddington cove northward.	....do	1-10,000	1862	......do	896
Part of the west shore of Rhode island, from Bristol bay southward.	....do	1-10,000	1861	......do	897
Cananicut island, part of Narraganset bay..	....do	1-10,000	1861	......do	898
Narraganset bay, including Coaster's Island harbor and adjacent shores.	....do	1-5,000	1862	H. L. Whiting	869
From McSparran Hill to Point Judith	....do	1-10,000	1839	J. J. S. Hassler	92
From McSparran Hill to Tiff's Hill, (interior).	....do	1-10,000	....	......do	93
From Point Judith to Noyes Point	....do	1-10,000	1839	......do	91
From Tiff's Hill westward, (interior)	....do	1-20,000	1839	......do	94
Kingston, from Fairbanks's Cut, northward..	....do	1-20,000	1840	......do	128
Joshua Champlin, Fairbanks's Cut to Sand Hill, southward.	....do	1-20,000	1840	......do	129
Block island	....do	1-10,000	1839	......do	90
From Big Hill to North Stonington, (interior).	....do	1-10,000	1840	F. H. Gerdes	126
Saughkonnet river, from Church's Point, northward.	....do	1-10,000	1844	H. L. Whiting	180
Entrance to Narraganset bay, Eastern Rock to Beaver Tail.	....do	1-10,000	1844	W. M. Boyce	182
Potter Hill, (interior)	R. I. and Conn..	1-10,000	1840	F. H. Gerdes	125
Milltown and interior, from North Stonington to Niantic village.	Connecticut	1-10,000	1840	......do	123
North Stonington and interior, from Eel's Hill to Quaquotogue.	....do	1-10,000	1840	......do	124
From Fort Hill to Mystic river	....do	1-10,000	1838	Charles Renard	65
From Mystic bridge to Noyes river, on Fisher's island.	....do	1-10,000	1839	F. H. Gerdes	88

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
From Lantern Hill to Thames river	Connecticut	1-10,000	1839	F. H. Gerdes	89
From Fort Hill to Black Point, including Niantic bay.	...do...	1-10,000	1838	Charles Renard	64
New London harbor, eastern shore of Thames river.	...do...	1-10,000	1846	J. B. Glück	85
Thames river, western shore	...do...	1-10,000	1846	...do...	84
Thames river, from New London to Mohican.	...do...	1-10,000	1839	F. H. Gerdes	86
Thames river, continued	...do...	1-10,000	1841	...do...	87
Between Niantic river and Thames river, (interior.)	...do...	1-10,000	1839	...do...	83
From Niantic river to Lynn city, (interior)	...do...	1-20,000	1838	Charles Preuss	78
From Black Point to Cornfield Point, mouth of Connecticut river.	...do...	1-10,000	1838	B. F. Sands	81
Mouth of Connecticut river	...do...	1-10,000	1850	H. L. Whiting	297
From Lynn city to Westbrook, (interior)	...do...	1-20,000	1838	Charles Hassler	79
From Cornfield Point to Hammonasset, Saybrook, and Clinton.	...do...	1-10,000	1838	J. J. S. Hassler.	80
From Essex to North Killingworth, including Clinton, (interior.)	...do...	1-10,000	1840	T. W. Werner	130
From North Killingworth to North Hill, East Haven, and Hammonasset.	...do...	1-10,000	1839	...do...	105
From Hammonasset Point to New Haven	...do...	1-10,000	1838	W. M. Boyce	82
From New Haven to Fair Haven, Catron's Rock, and Whitneyville.	...do...	1-10,000	1838	John Farley	76
From West Haven to Black Rock, (sound shore.	...do...	1-10,000	1837	C. M. Eaken	22
From Cheshire and Mount Carmel to Tashua and Mervin.	...do...	1-20,000	1839-'40	T. W. Werner	106
From Centre Redding to Wilton, east of Ridgefield.	...do...	1-20,000	1840	H. L. Dickens	131
From Tashua westward, Chestnut Hill to New Canaan.	...do...	1-10,000	1839	T. A. M. Craven	107
From Bridgeport to Saugatuck, Sherwood, and Gorham.	...do...	1-10,000	1838	...do...	51
From Black Rock to Norroton	...do...	1-10,000	1835	C. M. Eaken	19
From Saugatuck and West Brook to Darien, (interior.)	...do...	1-10,000	1838	T. A. M. Craven	50
Seafield and vicinity, (interior)	...do...	1-10,000	1839	...do...	108
From Round Hill to Newcastle, (interior)	...do...	1-10,000	1839	...do...	109
From Darien to Glenville and Horse Neck	...do...	1-10,000	1838	...do...	49
From Norroton Point to Delancy's Point, including Rye.	...do...	1-10,000	1836	C. M. Eaken	20
Fisher's island and others adjacent, Long Island sound.	New York	1-10,000	1838	F. H. Gerdes	57
Plum island and Gull island, Long Island sound.	...do...	1-10,000	1838	...do...	56
Gardiner's island, Long Island sound	...do...	1-10,000	1838	T. A. Jenkins	75
Long Island, from Montauk Point to Neapeague bay.	...do...	1-10,000	1838	B. F. Sands, C. Renard	62
Neapeague bay, vicinity of Amagansett, Long Island.	...do...	1-10,000	1845	Captain W. M. Boyce	61
From Neapeague to East Hampton	...do...	1-10,000	1838	Charles Renard	60
Bridge Hampton to Acabomock and East Hampton.	...do...	1-10,000	1838-'46	T.A.Jenkins, J.B.Glück.	74

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
Sag harbor, Gardiner's bay, and Three-mile harbor.	New York......	1-10,000	1838-'46	T.A.Jenkins, J.B.Glück.	72
Shelter island, Peconic bay, Long Island sound.	....do..........	1-10,000	1838	T. A. Jenkins..........	69
Cooper's Hill and Oyster Pond Point.......	....do..........	1-10,000	1838	F. H. Gerdes...........	55
North Peconic bay, from Catchoque to Halleck's Point.	....do..........	1-10,000	1838	T. A. Jenkins..........	68
Peconic bay, from Noyack to Sag harbor....	....do..........	1-10,000	1838	......do................	71
From Good Ground to East Hampton, (southern shore.)	....do..........	1-10,000	1838	Charles Renard.........	59
Southampton, interior of Long island......	....do..........	1-10,000	1838	T. A. Jenkins..........	73
Peconic bay, Good Ground to Noyack......	....do..........	1-10,000	1838	......do................	70
Peconic bay, Riverhead to Little Hog Neck.	....do..........	1-10,000	1838	......do................	67
Old Landing, Cooper's Hill and Cypress Points.	....do..........	1-10,000	1838	F. H. Gerdes...........	54
Friar's Head, Riverhead and Old Landing..	....do..........	1-10,000	1838	......do................	53
Smith's Point to Good Ground and Inlet West.	....do..........	1-10,000	1838	Charles Renard.........	58
From Ruland's to Riverhead, (interior).....	....do..........	1-20,000	1838	H. L. Dickens..........	77
Drowned Meadow harbor, Mount Misery, and Friar's head.	....do..........	1-10,000	1838	F. H. Gerdes...........	52
From Patchoque to Smith's Point..........	....do..........	1-10,000	1835	Charles Renard.........	2
West end of Fire island and Watch Hill....	....do..........	1-10,000	1834	....	479
From Stony Brook to Drowned Meadow, (interior.)	....do..........	1-20,000	1837	Charles Preuss..........	43
Setauket city and Drowned Meadow, Old Field Point and Mount Misery.	....do..........	1-10,000	1837	F. H. Gerdes............	32
From Old Field and Setauket to Stony Brook.	....do..........	1-10,000	1837	......do................	31
From Smithtown to Stony Brook, (interior).	....do..........	1-10,000	1837	....	42
From Babylon to Patchoque and George's Neck.	....do..........	1-10,000	1834	Charles Renard.........	1
From West Hills to Ruland's..............	....do..........	1-20,000	1837	H. L. Dickens..........	45
West Hills and vicinity, (interior)..........	....do..........	1-10,000	1836	......do................	44
Nissaquaque river, Smithtown and Stony Brook.	....do..........	1-10,000	1837	F. H. Gerdes...........	30
Red Hook, Bread and Cheese hollow, and Smithtown, (interior.)	....do..........	1-10,000	1837	Charles Preuss..........	41
Eaton's Neck to Smithtown, (interior)......	....do..........	1-10,000	1837	F. H. Gerdes	29
From North Port to Red Hook, (interior)...	....do..........	1-10,000	1837	Charles Preuss..........	40
Cow harbor, Northport, and Eaton's Neck ..	....do..........	1-10,000	1837	F. H. Gerdes	28
Lloyd's Neck to East Neck and Lloyd's harbor.	....do..........	1-10,000	1836	......do................	23
Huntington bay..........................	....do..........	1-10,000	1837	......do................	24
Oyster bay, Cold Spring, and Hog island...	....do..........	1-10,000	1837	......do................	25
From Babylon to Fire island and Rockaway.	....do..........	1-20,000	1835	Charles Benard.........	3
Hicksville and Jamaica, Brushville and Miltham.	....do..........	1-20,000	1837	T. A. Jenkins...........	37
From Newlet's to Jamaica and Hicksville ..	....do..........	1-20,000	1837	......do................	38
From Glencove to Oyster bay, (interior)....	....do..........	1-10,000	1838	Charles Preuss..........	39
From Cold Spring to Glencove	....do..........	1-20,000	1838	T. A. Jenkins...........	66
Hog island, Matinicock Point, and Red Spring.	....do..........	1-10,000	1837	F. H. Gerdes	26
Matinicock and Hempstead harbor.........	....do..........	1-10,000	1837	......do................	27

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Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
Cow Neck and Manhassit	New York	1-10,000	1837	T. W. Werner	34
From Great Neck to Bowen Station	do	1-10,000	1837-'50	T. W. Werner, H. L. Whiting.	33
Hewlet's Cove, Wilkin's point, and Great bay.	do	1-10,000	1837	Charles Renard	14
Hell Gate and vicinity	do	1-5,000	1848	H. L. Whiting	258
From Hell Gate to Brooklyn	do	1-10,000	1855	F. H. Gerdes	483
From Throg's Neck to Ward's island	do	1-10,000		do	488
Ward's, Randall's, N. and S. Brother, and Riker's islands.	do	1-5,000	1857	H. L. Whiting	675
From Little bay to Flushing bay	do	1-10,000	1858	C. Rockwell	605
From Flushing bay to Hunter's Point	do	1-10,000	1858	H. L. Whiting	808
Part of Brooklyn, including Williamsburg and Greenpoint.	do			F. W. Dorr	789
From Hewlet's Cove to Brooklyn	do	1-10,000	1837	Charles Renard	13
New York, Brooklyn, and vicinity	do			A. Boschke	608
Long Island, (interior,) between Brooklyn, Flushing, and Jamaica.	do		1862	H. L. Whiting	924
From Brooklyn to Jamaica	do	1-20,000	1837	T. A. Jenkins	36
Reconnaissance of Brooklyn, Williamsburg, and Greenpoint.	do	1-10,000	1863	F. H. Gerdes	917
From Brooklyn to Fort Hamilton and Gowanus island.	do	1-10,000	1837	Charles Renard	12
Vicinity of Gowanus bay	do	1-10,000	1856	S. A. Gilbert	599
Vicinity of Gowanus bay	do	1-10,000	1856	do	598
Gowanus bay and vicinity	do	1-10,000	1856	do	597
From Gowanus bay to Bath	do	1-10,000	1855	do	487
From Fort Hamilton to Coney island	do	1-10,000	1835	Charles Renard	5
Coney island and Dead Horse inlet	do		1855-'56	S. A. Gilbert	586
From Coney island to Rockaway Pavilion	do	1-20,000	1835	Charles Renard	4
Barren island, Rockaway beach	do	1-20,000		S. A. Gilbert	535
Part of Far Rockaway, Long Island	do	1-9,833	1860	F. W. Dorr	798
Staten Island	do	1-10,000	1835-'36	Charles Renard	9
Tomkinsville, Staten Island	do	1-5,000	1835	do	6
Raritan bay from Great Kills to Ward's Point.	do	1-10,000	1855	A. S. Wadsworth	532
From New Brighton to Great Kills, Staten Island.	do	1-10,000	1855	do	490
Staten Island from Ward's Point to Great Kills.	do	1-10,000	1856	H. L. Whiting	680
Northwestern position of Staten Island and Bergen Point.	do	1-10,000	1857	do	751
Staten Island from New Brighton to Fresh Kills.	do	1-10,000	1856	do	816
Bedloe's and Ellis's, islands, New York harbor.	do	1-10,000	1855	F. H. Gerdes	543
Governor's, Ellis's, and Bedloe's islands	do	1-5,000	1857	John Mechan	677
Manhattan island, eastern part, New York city to West Farms.	do	1-10,000	1837	Charles Renard	16
New York city and Manhattan island	do	1-10,000	1854-'55	F. H. Gerdes	475
Manhattan island from Macomb's dam to Spuyten Duyvel creek.	do	1-10,000	1857	John Mechan	658
Harlem river, east side, from High Bridge to King's Bridge.	do	1-10,000	1859	C. Rockwell	775

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
Harlem river and Throg's Neck	New York	1–10,000	1837	Charles Renard	15
Throg's Neck to Harlem river	do	1–10,000	1857	F. W. Dorr	604
From Throg's Neck to Rodman's Point	do	1–10,000	1837	W. M. Boyce	46
Hudson river, King's bridge and vicinity	do	1–10,000	1839	T. A. M. Craven	113
Hudson river, Greensburg and vicinity	do	1–10,000	1839	do	112
Rye Point, Delaney's Point, and Rodman's Neck.	do	1–10,000	1837	C. M. Eakin	21
From Horse Neck to Rye	do	1–10,000	1838	T. A. M. Craven	48
From Field West to Round Hill	do	1–10,000	1839	do	110
From North Castle to Hudson river, at Tarrytown.	do	1–10,000	1839	do	111
From Croton Point, Hudson river, to Baker's Hill and Bald Hill.	do	1–20,000	1839	H. L. Dickens	95
Hudson river, vicinity of Godwinsville	do	1–20,000	1840	do	132
From Communipaw to Palmipaw	do	1–10,000	1857	John Mechan	662
Hudson river, from Jersey City to Gutenburg.	do	1–10,000	1855	F. H. Gerdes	484
Hudson river, from Gutenburg to Jersey City.	do	1–10,000	1857	H. L. Whiting	610
Hudson river, from Gutenburg to Tubbyhook.	do	1–10,000	1855	F. H. Gerdes	485
Hudson river, Bull's Ferry to Fort Washington.	do	1–10,000	1857	H. L. Whiting	609
Hudson river, from Spuyten Duyvel creek to Yonkers.	do	1–10,000	1859	H. L. Whiting, C. Rockwell.	810
Hudson river, from Yonkers to Hastings	do	1–10,000	1859	C. Rockwell	811
Hudson river, from Spuyten Duyvel creek to Fort Washington.	do	1–10,000	1853	F. H. Gerdes	418
Hudson river, from Spuyten Duyvel creek to Sounding Point.	do	1–10,000	1853	do	419
Hudson river, from Hastings to Tarrytown	do	1–10,000	1853	do	420
Hudson river, from near Tarrytown to Croton.	do	1–10,000	1862–'64	H. L. Whiting	968
Hudson river, from Hastings to Irvington	do	1–10,000	1860	J. Mechan	800
Hudson river, from Irvington to Paulus Hook mountain.	do	1–10,000	1859	do	770
Hudson river, west side, from Hook mountain to Haverstraw.	do	1–10,000	1864	H. L. Whiting	969
Hudson river, from Tarrytown to Croton river.	do	1–10,000	1853	F. H. Gerdes	421
Hudson river, from Sing Sing to Stony Point.	do	1–10,000	1854	do	468
Hudson river, from Haverstraw bay to Anthony's Nose.	do	1–10,000	1854	do	480
Rondout creek	do	1–5,000	1858	C. Fendall	727
Esopus creek	do	1–5,000	1858	do	726
Hudson river, from New Baltimore to Ten Eyck.	do	1–5,00	1856	A. Strausz	692
Hudson river, above New Baltimore	do	1–10,000	1856	A. S. Wadsworth	596
Hudson river, from Albany, No. 1	do	1–10,000	1856	do	593
Hudson river, from Albany, No. 2	do	1–10,000	1856	do	594
Hudson river, from Albany, No. 3	do	1–10,000	1856	do	595
From Fort Lee to Jersey City	New Jersey	1–10,000	1837	Charles Renard	17
From Fort Lee to Boomper's Hook	do	1–10,000	1839	T. A. Jenkins	96

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
From North Scalenburg to Passaic river	New Jersey	1-10,000	1839	T. A. Jenkins	97
From Paterson to Weasel, (interior)	do	1-10,000	1839	do	99
From Weasel Mount to Springfield, (interior.)	do	1-10,000	1839	do	102
From Hackensack to Newark and Elizabethtown.	do	1-10,000	1839	do	100
Hackensack to Paterson, (interior)	do	1-10,000	1839	do	98
From Jersey City to Caven Point	do	1-10,000	1855	A. S. Wadsworth	482
Passaic river and Newark Neck	do	1-10,000	1858	F. W. Dorr	734
Bergen Neck to Centreville to New Jersey railroad.	do	1-10,000	1858	do	733
Western part of Newark bay and Staten Island sound.	do	1-10,000	1858	do	729
From Jersey Point to Constable Point	do	1-10,000	1837	Charles Renard	18
From Caven Point to Constable Point	do	1-10,000	1855	A. S. Wadsworth	489
Kill Van Kull and Newark bay	do	1-10,000	1855	do	533
New Market, (interior)	do	1-10,000	1840	T. A. M. Craven	134
Bound Brook, (interior)	do	1-10,000	1840	do	135
New Brunswick and vicinity	do	1-10,000	1840	do	136
Sandhills and vicinity	do	1-20,000	1840-'41	do	137
Princeton and vicinity, (interior)	do	1-20,000	1840	F. H. Gerdes	127
Interior between Princeton, Trenton, and Pennington.	do	1-20,000	1841	T. A. M. Craven	144
Between Shrewsbury and Princeton, (interior.)	do	1-20,000	1841	H. L. Dickens	145
From Shrewsbury to New Brunswick, (interior.)	do	1-20,000	1840	B. F. Sands	122
From Elizabethtown, eastward	do	1-10,000	1836	Charles Renard, T. A. Jenkins.	10
From Perth Amboy to Elizabethtown	do	1-10,000	1836	Charles Renard	8
Elizabethport to Rahway creek	do	1-10,000	1855	A. S. Wadsworth.	530
Bellville, (interior)	do	1-10,000	1839	T. A. Jenkins	101
Rahway, (interior)	do	1-10,000	1839	do	104
Springfield, (interior)	do	1-10,000	1839	do	103
South Rahway, (interior)	do	1-10,000	1840	T. A. M. Craven	133
From Fresh Kills, southward	do	1-10,000	1855	A. S. Wadsworth	531
From Perth Amboy to Woodbridge	do	1-10,000	1855	Hull Adams	534
Raritan Valley, from Perth Amboy to New Brunswick.	do	1-10,000	1836	Chas. Renard	11
Navesink to South Amboy	do	1-20,000	1836	do	7
Raritan bay, from Eastpoint to South Amboy	do	1-10,000	1855	A. M. Harrison	542
Raritan bay, Cowhead to Point Comfort	do	1-10,000	1855	do	541
Sandy Hook and highlands of Navesink	do	1-10,000	1855	do	486
Sandy Hook, shore line	do	1-10,000	1853	F. H. Gerdes	413
Sandy Hook, northward of Ocean House	do	1-10,000	1851	R. M. Bache	342
Sandy Hook	do	1-20,000	1850	H. L. Whiting	278
Sandy Hook, island	do	1-20,000	1848	S. A. Gilbert	252
Sandy Hook	do	1-5,000	1836	Chas. Renard	239
Sandy Hook, resurvey of	do	1-5,000	1862	H. L. Whiting	894
From Navesink to Poplar creek	do	1-10,000	1839	B. F. Sands	114
From Poplar creek to Manasquam	do	1-10,000	1839	do	115
Interior, in vicinity of Squam	do	1-20,000	1842	H. L. Dickens	158
Manasquam to Metiticonk	do	1-10,000	1839	B. F. Sands	116
From Metiticonk to Barnegat inlet	do	1-20,000	1839	Chas. Renard	120
Metiticonk to Cedar creek	do	1-10,000	1839	B. F. Sands	117

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Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
Interior, Goose creek and Good Luck Point.	New Jersey	1–20,000	1842	H. L. Dickens	159
Vicinity of Goose creek, (interior)	....do..........	1–20,000	1842	....do..................	160
From Cedar creek to Barnegat	....do..........	1–10,000	1839	B. F. Sands.............	118
From Barnegat inlet to Great Swamp	....do..........	1–20,000	1839	Chas. Renard, B. F. Sands	121
From Barnegat bay to Little Egg harbor....	....do..........	1–20,000	1839–'41	B. F. Sands.............	119
From Little Egg harbor to Dry inlet	....do..........	1–20,000	1841	....do..................	142
From Dry inlet to Great Egg harbor	....do..........	1–10,000	1841	....do..................	143
From Great Egg harbor to Corson's inlet ...	....do..........	1–10,000	1842	....do..................	146
Absecom inlet	....do..........	1–10,000	1864	H. W. Bache	952
From Corson's inlet to Cape May Court-House.	....do..........	1–10,000	1842	B. F. Sands	147
Cape May Court-House to Cape May island.	....do..........	1–10,000	1842	Geo. D. Wise	148
From Cape May light to Cape May Court-House.	....do..........	1–10,000	1842	....do..................	149
From Cape May Court-House to Dennis's creek.	....do..........	1–10,000	1842	F. H. Gerdes	153
From Goshen to Fishing creek, peninsula of Cape May.	....do..........	1–10,000	1842	....do..................	154
From Greenwich creek to Dennisville, (interior.)	....do..........	1–20,000	1842	H. L. Whiting	157
From Ben Davis's Point to Dennis creek, Delaware bay.	....do..........	1–20,000	1842	F. H. Gerdes............	152
From Liston's Point to Ben Davis's Point, Delaware river.	....do..........	1–20,000	1841	....do..................	63
From Greenwich creek and Cohansey to Salem creek.	....do..........	1–20,000	1842	H. L. Whiting	155
From Salem creek to opposite Penn Grove ..	....do..........	1–10,000	1843	....do..................	156
From Salem creek to Penn Grove..........	....do..........	1–20,000	1846	J. J. S. Hassler	163
League Island channel and vicinity	Pennsylvania...	1–2,500	1865	R. M. Bache	975
Stakes in the gut east of the bridge, League island.	....do..........	1–2,500	1865	....do..................	975 *bis.*
From Lazaretto to mouth of Schuylkill river.	N. J. and Penn..	1–10,000	1842	W. M. Boyce	164
Part of Philadelphia, Camden, N. J., and vicinity.	....do..........	1–10,000	1843	....do..................	165
Part of Philadelphia and New Jersey side of Delaware river.	....do..........	1–5,000	1843	....do..................	166
From Cowperthwaite to Cooper's Point, Rancocas creek.	....do..........	1–10,000	1843–'44	J. J. S. Hassler	168
From Rancocas creek to Burlington and Bristol.	....do..........	1–10,000	1843–'44	....do..................	167
From New Cold island to White Hill.......	....do..........	1–10,000	1843–'44	....do..................	173
From White Hill to Trenton...............	....do..........	1–10,000	1843–'44	Geo. D. Wise	172
From Bristol to New Cold island	....do..........	1–10,000	1843–'44	J. J. S. Hassler	171
From Penn's Grove to Lazaretto...........	....	1–10,000	1841–'42	W. M. Boyce	161
Lazaretto to Dupont's wharf	....	1–20,000	1846	J. J. S. Hassler	162
From Wilmington to Pea Patch island	N. J. and Penn..	1–10,000	1841	F. H. Gerdes	138
Wilmington to Newcastle..................	....do..........	1–10,000	1839	......do................	139
From Wilmington to Iron Hill, (interior)...	Del. and Md....	1–20,000	1843	T. W. Werner	169
From Ash signal to Rigg's Hill, (interior) ..	....do..........	1–20,000	1843	......do................	170
From Pea Patch island to Liston's Tree	N. J. and Del ..	1–10,000	1841	F. H. Gerdes............	140
From Liston's Point to Ben. Davis's Point..	....do..........	1–10,000	1841	......do................	141
Bombay Hook island to Mispillion light	Delaware	1–20,000	1842	......do................	150
From Mispillion light to Cape Henlopen....	....do..........	1–20,000	1842	......do................	151
From Cape Henlopen to Indian river.......	....do..........	1–20,000	1845	J. J. S. Hassler	226

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From Salt Point beach to Dromedary signal..	Del. and Md....	1–20,000	1850	George D. Wise........	299
Beach House to South Birch	Maryland	1–20,000	1849	......do..............	263
Head of Assateague bay to Pope's island ...	....do..........	1–20,000	1850	......do..............	264
From Pope's Island beach to Lonesome Hill.	....do..........	1–20,000	1850	......do..............	311
Assateague island and Parker's bay........	....do..........	1–20,000	1859	C. Ferguson...........	763
Lonesome Hill to Chincoteague inlet.......	....do..........	1–20,000	1849	George D. Wise........	522
Coast southward to Little inlet	....do..........	1–20,000	1849	......do..............	524
Chincoteague inlet and bay................	Virginia	1–20,000	1858	N. S. Finney	704
Chincoteague bay.........................	....do..........	1–20,000	1858	C. Ferguson...........	723
Chincoteague inlet and vicinity............	....do..........	1–20,000	1856	George D. Wise	580
Wallop's island and Assawaman island	....do..........	1–20,000	1851	W. M. Johnson	378
From Wallop's island to westward of Gargathy inlet.	....do..........	1–20,000	1855	George D. Wise........	492
From Gargathy to Wachapreague inlet.....	....do..........	1–20,000	1852–'54	......do..............	464
Wachapreague inlet and vicinity	....do..........	1–20,000	1852	......do..............	510
Little Machipongo, Paramore's island, and Wachapreague.	....do..........	1–20,000	1852	......do..............	512
Great and Little Machipongo inlets	....do..........	1–20,000	1852	......do..............	511
Great Machipongo inlet to Little inlet......	....do..........	1–20,000	1853	......do..............	523
New inlet southward to Smith's Island light.	....do..........	1–20,000	1852	......do..............	525
From New inlet to Cape Charles...........	....do..........	1–20,000	....	......do..............	509
Entrance to Chesapeake bay, (practice sheet).	....do..........	1–20,000	1853	S. A. Wainwright	394
From Cherrystone inlet southward to Corten's station.	....do..........	1–20,000	1852	John Seib..............	495
Occohannock, Naswaddox, and Hunger's creeks.	....do..........	1–20,000	1851	......do..............	350
From Sandy Point to Pungoteague creek...	....do..........	1–20,000	1850	J. Seib, S. A. Wainwright	307
Pungoteague creek to Chesconessex and Onancock creek.	....do..........	1–20,000	1850	......do..............	308
Pocomoke sound and bay.................	....do..........	1–20,000	1851	......do..............	349
Tangier island and Watt's island	....do..........	1–20,000	1850	......do..............	309
Pocomoke sound, from Guilford creek to Messanger.	....do..........	1–20,000	....	S. A. Wainwright	529
Pocomoke sound, Ape's Hole creek	Maryland	1–20,000	....	......do..............	528
From Fox island to Little Annemessex river.	....do..........	1–20,000	1849–'51	R. D. Cutts, J. Seib, and S. A. Wainwright.	272
Deil's island and Manokin river	....do..........	1–20,000	1849	......do..............	270
Smith's island, Chesapeake bay	....do..........	1–20,000	1849	John Seib..............	271
Bloodsworth island and South Marsh island.	....do..........	1–20,000	1849	......do..............	269
Tanquier sound and Wicomico river.......	....do..........	1–20,000	1849	R. D. Cutts, J. Seib, and S. A. Wainwright.	268
Fishing bay and part of Nanticoke river....	....do..........	1–20,000	1849	......do..............	267
Part of Nanticoke river, vicinity of Vienna..	....do..........	1–20,000	1849	J. Seib, S. A. Wainwright	266
Mouth of Hongo river and Cooper's straits..	....do..........	1–20,000	1848	R. D. Cutts, J. Seib......	265
Hongo river, upper part	....do..........	1–20,000	1848	R. D. Cutts.............	255
Meekin's Neck, (included in No. 255)	....do..........	1–20,000	1854	H. L. Whiting	451
Little Choptank river, from Meekin's Neck to Cook's Point.	....do..........	1–20,000	1847–'48	George D. Wise.........	250
Sharp's island, Chesapeake bay	....do..........	1–20,000	1848	......do..............	251
Mouth of Choptank river, Cook's Point to Cambridge.	....do..........	1–20,000	1847	R. D. Cutts.............	225
Choptank river, from Hanbrook's Point to Cabin creek.	....do..........	1–20,000	1848	......do..............	253
Choptank river, from Cabin creek to Wing's Landing.	....do..........	1–20,000	1848	......do..............	254

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Potomac river, from Cobb Point to Swan Point.	Maryland	1-20,000	1862	C. Hosmer	858
Potomac river, from Swan Point to the Trunk	do	1-20,000	1862	J. Mechan	859
Potomac river, from Lone Point to Persimmon Point.	Virginia	1-20,000	1862	do	860
Potomac river, from Metomkin to Persimmon Point.	Md. and Va	1-20,000	1862	H. L. Whiting	861
Potomac river, Cedar Point to Nanjemoy Store.	Maryland	1-20,000	1862	J. Mechan	862
Potomac river, from Smith's Point to Nanjemoy Store.	do	1-20,000	1862	A. W. Longfellow	863
Potomac river, Metomkin Point to Aquia creek.	Virginia	1-20,000	1862	J. Mechan	864
Potomac river, from Smith's Point to Fair Oaks.	Md. and Va	1-20,000	1862	C. Hosmer	865
Potomac river, from Fair Oaks to Indian Head.	Maryland	1-20,000	1862	A. W. Longfellow	866
Potomac river, from Shipping Point to High Point.	Virginia	1-20,000	1862	J. Mechan	867
Potomac river, from Indian Head to Fox Ferry.	Md. and Va	1-20,000	1862	C. Hosmer	875
Potomac river, Broad creek to Oxen Hill	Maryland	1-10,000	1863	A. M. Harrison	902
St. Michael's river and Third Haven creek	do	1-20,000	1847	R. D. Cutts	224
Kent island, Eastern bay, Wye and St. Michael's rivers.	do	1-20,000	1847	do	223
From Ward's Point to Locust Point, Sharp's island and Poplar island.	do	1-20,000	1846-'47	George D. Wise	215
Kent island base and vicinity	do	1-10,000	1844	H. L. Whiting	181
Part of Kent island	do	1-20,000	1847	R. D. Cutts	222
Mouth of Chester river	do	1-20,000	1846	J. C. Neilson	200
Shores of Chester river	do	1-20,000	1846	do	201
From Swan creek to Eastern Neck inlet	do	1-20,000	1846	R. D. Cutts	199
From Swan Point to Wharton Point and Pool's island.	do	1-20,000	1845	do	187
Head of Chesapeake bay, from Susquehanna river to Bush river.	do	1-20,000	1845	George D. Wise	212
Sassafras river entrance	do	1-20,000	1854	H. L. Whiting	469
Sassafras river	do	1-20,000	1846	J. J. S. Hassler	279
Elk and Bohemia rivers and Back creek	do	1-20,000	1845-'55	J. J. S. Hassler, H. L. Whiting.	186
Elk river	do	1-20,000	1860	H. Adams	788
Northeast river entrance	do	1-10,000	1844-'45	J. J. S. Hassler	185
Northeast river	do	1-10,000	1844-'45	do	184
Susquehanna river, Havre de Grace, and Port Deposit.	do	1-10,000	1845	R. D. Cutts	189
Head of Chesapeake bay, from Havre de Grace to Spesutic creek.	do	1-10,000	1845	do	188
From Swan creek to Bush river	do	1-20,000	1845-'46	do	190
Bush, Gunpowder, Beach, and Middle rivers	do	1-20,000	1846-'47	George D. Wise	213
From Bush river to Baltimore city	do	1-20,000	1846	R. D. Cutts	197
Back river	do	1-20,000	1846-'47	George D. Wise	214
North chop of Back river, Miller's and Pool's islands.	do	1-20,000	1854	H. L. Whiting	450
Patapsco Neck, Bear creek to North Point	do	1-20,000	1853	do	436
Patapsco river, eastern shore	do	1-20,000	1845-'46	George D. Wise	218

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Patapsco river, eastern shore	Maryland	1-20,000	1845-'46	George D. Wise	219
Patapsco river, from Colegate creek to Bear creek.	....do	1-20,000	1852	H. L. Whiting	401
Baltimore city.	....do	1-10,000	1845	George D. Wise	216
Baltimore city	....do	1-10,000	1849	J. B. Glück	217
Vicinity of Baltimore, west side	....do	1-10,000	1863	J. W. Donn	929
Vicinity of Baltimore, northwest side	....do	1-10,000	1864	C. M. Bache	936
Vicinity of Baltimore, northeast side	....do	1-10,000	1864	C. T. Iardella	955
Vicinity of Baltimore, west side	....do	1-10,000	1865	......do	977
Patapsco river	....do	1-20,000	1847	George D. Wise	221
Patapsco river, western shore	....do	1-20,000	1846	......do	220
Patapsco river	....do	1-10,000	1851-'55	J. B. Glück, H. L. Whiting	306
Patapsco river, south shore	....do	1-10,000	1865	C. T. Iardella	983
From Sandy Point and Merrick to Bodkin Point.	....do	1-10,000	1844	F. H. Gerdes	175
Magothy river, Chesapeake bay	....do	1-10,000	1845	......do	179
From Sandy Point to Thomas Point and mouth of Severn river.	....do	1-10,000	1844	......do	174
Severn river, Hackett's Point to Cedar Point.	....do	1-10,000	1844	......do	176
Severn river, (included in No. 176)	....do	1-10,000	1844		177
South river, Chesapeake bay	....do	1-20,000	1847	George D. Wise	248
South river, (included in No. 248)	....do	1-20,000	1847	......do	249
South river, (included in No. 176)	....do	1-10,000	1844		178
From Sanders's Point to Chew's and West river.	....do	1-20,000	1846	R. D. Cutts	198
From Chew's to Parker's creek	....do	1-20,000	1847	J. J. S. Hassler	280
From Parker's creek to Cove Point	....do	1-20,000	1847	......do	281
Cove Point and vicinity	....do	1-20,000	1852	John Seib	388
Patuxent river entrance, Cove Point to Drum Point.	....do	1-20,000	1848	R. D. Cutts	256
Patuxent river, from Point Peterson to Rattle creek.	....do	1-10,000	1860	H. Adams	812
Patuxent river, from Rattle creek to God's Grace Point.	....do	1-10,000	1860	......do	813
Patuxent river, from God's Grace Point to Point Sollin.	....do	1-10,000	1859	......do	814
Patuxent river, from Point Sollin to Point Jones.	....do	1-10,000	1859	......do	815
Jenkins's creek, Cambridge, Oyster Point, and Jamaica Point.	....do	1-20,000	1848	R. D. Cutts, John Seib	257
Potomac river entrance	....do	1-20,000	1849-'56	......do	458
St. Mary's river	....do	1-20,000	1858-'59	H. Adams	776
St. George's island, St. Mary's river	....do	1-20,000	1859	......do	804
Williamsport and vicinity	....do	1-20,000	1862	J. Mechan, C. Hosmer	879
Vicinity of Rosier's Bluff	....do	1-5,000	1862	A. M. Harrison	895
From Bladensburg to Leesboro', adjacent to District of Columbia.	....do	1-15,000	1863	C. Ferguson	903
Vicinity of District of Columbia, (southeast portion.)	....do	1-15,000	1863	J. W. Donn	925
Northeast side of District of Columbia	....do	1-15,000	1863-'64	Ferguson and Adams	950
Tenallytown to Great Falls	....do	1-15,000	1864	F. W. Dorr	945
Tenallytown to Rockville	....do	1-15,000	1864	......do	946
Jones's Point, Potomac river	Virginia	1-10,000	1863	A. M. Harrison	905
Jones's Point, near Alexandria; continuation of special survey.	....do	1-1,000	1863	C. M. Bache	909

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Potomac river, from Jones's Point to Little Falls bridge.	Virginia	1-15,000	1863	C. H. Boyd	910
Topography around Fort Lyon	....do	1-10,000	1863	C. M. Bache	916
Alexandria to Bailey's Cross-roads	....do	1-15,000	1864	F. W. Dorr	941
Bailey's Cross-roads to Miner's Hill	....do	1-15,000	1864	C. Rockwell	942
Alexandria to Mount Vernon	....do	1-15,000	1864	J. Mechan	947
Alexandria to Burke's station	....do	1-15,000	1864	F. W. Dorr	949
Dogue run to Fairfax road	....do	1-15,000	1861	J. Mechan	948
Aqueduct to Chain bridge	....do	1-15,000	1864	Dorr, Mechan, Robbins	943
Chain bridge to Prospect Hill	....do	1-15,000	1864	F. W. Dorr	944
Vicinity of Forts Ethan Allen and Marcy	....do	1-15,000	1864	T. W. Robbins	951
Potomac river, from Sharpsburg to Berlin	Maryland	1-10,000	1865	John W. Donn	985
Potomac river, from Berlin to Hester's island	....do	1-10,000	1865	......do	986
Potomac river, from Hester's island to White's ferry.	....do	1-10,000	1865	......do	987
Potomac river, from White's ferry to Young's island.	....do	1-10,100	1865	......do	988
Potomac river, from Young's island to Rushville.	....do	1-10,000	1865	......do	989
Potomac river, from Rushville to Great Falls	....do	1-10,000	1865	......do	990
Entrances to Great Wicomico and Potomac rivers.	Virginia	1-20,000	1850-'56	John Seib	500
Ingram's bay, Dividing creek, and Fleet's bay.	....do	1-20,000	1850	J. Seib, S. A. Wainwright.	310
Rappahannock river, entrance	....do	1-10,000	1851-'56	John Seib	521
Rappahannock river, Mechim's creek to Stiff.	....do	1-10,000	1857	Hull Adams	660
Rappahannock river, Bailey's Bluff to Mechim's creek.	....do	1-10,000	1857	......do	659
Rappahannock river and Currotoman	....do	1-10,000	1857	......do	661
Rappahannock river	....do	1-10,000	1856	......do	603
Rappahannock river, Lagrange to Punchbowl.	....do	1-10,000	1856	......do	602
Rappahannock river, Punchbowl to Layton	....do	1-10,000	1855	John Seib, A. Strausz	520
Rappahannock river, Layton to Accaceek Point.	....do	1-10,000	1855	......do	519
Rappahannock river, from Accaceek Point to Ferry Marsh.	....do	1-10,000	1855	......do	518
Rappahannock river, from Ferry Marsh to Cliff.	....do	1-10,000	1855	......do	517
Rappahannock river, from Cliff to Leeds	....do	1-10,000	1855	......do	516
Rappahannock river, from Leeds to Brick Quarter.	....do	1-10,000	1855	......do	515
Rappahannock river, Brick Quarter to Holland Point.	....do	1-10,000	1854	John Seib	514
Rappahannock river, Holland Point to Lamb's creek.	....do	1-10,000	1853-'54	......do	513
Rappahannock river, above Corbin's Neck	....do	1-10,000	1853	......do	435
Rappahannock river, from Taylor to Falmouth.	....do	1-10,000	1853	......do	434
Manassas, rebel defences	....do	1-10,000	1862	H. L. Whiting, C. M. Bache	848
Fredericksburg, vicinity of	....do	1-10,000	1862	C. M. Bache	871
Rappahannock river, part of the left bank in the vicinity of Fredericksburg.	....do	1-10,000	1862	T. W. Robbins	872

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Rappahannock river, reconnaissance of roads, part of left bank.	Virginia	1-10,000	1862	T. W. Robbins	873
Chesapeake bay, from Wolf Trap to Cherry Point.	do	1-20,000	1853	John Seib	503
Mobjack bay, tributary of Chesapeake	do	1-20,000	1853	do	504
Mouth of York river	do	1-20,000	1853-'54	do	496
York river, from Wormley to Clay Bank	do	1-20,000	1857	do	685
York river, from Clay Bank to Mount Folly.	do	1-20,000	1857-'58	do	686
York river, from Mount Folly to West Point.	do	1-20,000	1858	do	722
Back river and Pocosin river entrances	do	1-20,000	1853-'54	do	499
Old Point Comfort and entrance to Hampton roads.	do	1-20,000	1853-'54	do	502
Hampton roads and vicinity	do	1-20,000	1853	do	501
James river entrance	do	1-20,000	1853	do	497
James river, from Maycox Point to City Point.	do	1-10,000	1853	do	431
Appomattox river, from City Point to Point Walthall.	do	1-10,000	1853	do	390
Part of Appomattox river and Petersburg	do	1-10,000	1853	J. Seib, S. A. Wainwright.	389
James river, from City Point to Curl's Neck.	do	1-10,000	1853	John Seib	430
James river, from Curl's Neck to Dutch Gap	do	1-10,000	1853	do	429
James river, from Dutch Gap to Wilton	do	1-10,000	1853	do	428
James river, from Warwick bar to Richmond bar.	do	1-5,000	1853	S. A. Wainwright	392
James river, from Drury island to Mayo's bridge.	do	1-5,000	1853	do	391
James river, Trent's Reach	do	1-5,000	1853	do	393
Richmond city	do	1-5,000	1857-'58	H. Adams	684
Nansemond river, upper part	do			John Seib	505
Elizabeth river, entrance	do	1-20,000		do	498
Norfolk harbor	do	1-10,000	1856	do	506
United States navy yard, Gosport, and rebel battery at St. Helena, opposite the navy yard.	do	1-2,500	1862	A. M. Harrison	850
Plans of confederate fortifications, Elizabeth river.	do	1-2,500	1862	do	851
Lynn Haven roads	do	1-20,000	1852	John Seib	507
Cape Henry	do	1-20,000	1859	J. J. S. Hassler, J. Mechan.	753
Back bay	do	1-20,000	1859	do	743
North river	do	1-20,000	1859	J. Mechan	754
Head of Currituck sound	Va. and N. C.	1-20,000	1858	J. J. S. Hassler, J. Mechan.	736
Accomack county, part of	Virginia	1-20,000	1862	C. Hosmer	868
Line across the peninsula of Eastern Virginia, Accomack county.	do	1-20,000	1862	A. M. Harrison	890
Currituck sound	North Carolina	1-20,000	1857	J. J. S. Hassler	657
Currituck sound, from North Banks to Jones's Hill.	do	1-20,000	1851-'52	do	381
Currituck sound, from North Banks to North river.	do	1-20,000	1848-'49	do	292
Pasquotank river, from entrance to Floating bridge.	do	1-20,000	1847	J. C. Neilson	207
Camden and Wade's Points, Albemarle sound.	do	1-20,000	1861	J. Mechan	837
Big Flatty river, Albemarle sound	do	1-20,000	1847	J. C. Neilson	208
Little river and environs, Albemarle sound	do	1-20,000	1847	do	209

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ATLANTIC COAST—Continued.					
Perquimons river, Albemarle sound	North Carolina	1-20,000	1847	J. C. Neilson	210
Albemarle sound, from Smith's Point to Sandy Point.	do	1-20,000	1848	J. J. S. Hassler	247
Albemarle sound, from Laurel Point to Smith's Point.	do	1-20,000	1848	do	211
Chowan river, mouth of, Albemarle sound	do	1-20,000	1860-'61	J. Mechan	824
Roanoke river, mouth of, Albemarle sound	do	1-20,000	1861	do	836
Roanoke, Eastmost, Middle, and Cashai rivers and vicinity.	do	1-20,000	1864	R. E. Halter	922
Albemarle sound, from Long shoal to Laurel Point.	do	1-20,000	1848	J. J. S. Hassler	246
Alligator river, from Cypress creek to Long shoal.	do	1-20,000	1849	A. W. Longfellow	284
Alligator river, from Cypress Point to Bear Point.	do	1-20,000	1849	do	285
Albemarle sound, Durant's island, Hollover	do	1-20,000	1848-'49	J. J. S. Hassler	293
Durant's island, Albemarle sound	do	1-20,000	1861	J. Mechan	825
Roanoke sound, Kill Devil Hills to Nag's Head.	do		1851	J. J. S. Hassler	351
Croatan sound and lower end of Roanoke island.	do	1-20,000	1864	R. E. Halter	933
Roanoke island, part of	do	1-20,000	1861	J. Mechan	826
Bodie's island, Nag's Head to Wreck	do	1-20,000	1849	A. W. Longfellow	354
Bodie's island, part of	do	1-20,000	1860	J. Mechan	791
From Wreck Stafford to Bay signal	do	1-20,000	1852	Hull Adams	367
From Bay signal to Cape Hatteras	do	1-20,000	1852	do	377
From Cape Hatteras to Hatteras inlet	do	1-20,000	1860	J. Mechan	790
From Hatteras inlet to Great Swash	do	1-20,000	1860	do	792
Hatteras inlet	do	1-20,000	1852	Hull Adams	372
Hatteras inlet	do	1-10,000	1857	J. Mechan	623
Ocracoke inlet	do	1-20,000	1852	Hull Adams	376
Ocracoke inlet	do	1-10,000	1857	J. Mechan	622
Neuse river, (shore-line)	do	1-20,000	1863-'64	A. Strausz	928
Goldsborough, western approaches, including its defences.	do		1865	F. W. Dorr	970
Goldsborough, eastern approaches to	do	1-10,000	1865	C. Rockwell	971
Cape Lookout and part of Cove sound	do	1-20,000	1853	A. S. Wadsworth	416
Beaufort harbor	do	1-10,000	1851	H. L. Whiting	315
Beaufort harbor	do	1-10,000	1851	Charles P. Bolles	348
Beaufort harbor	do	1-20,000	1854	A. S. Wadsworth	438
Beaufort harbor, resurvey	do	1-10,000	1862	A. Boschke	874
New river and part of Stump sound	do	1-10,000	1856	A. S. Wadsworth, J. Mechan	558
Topsail sound and Stump sound	do	1-10,000	1856	do do	565
Topsail sound, from Water's bay to Old Topsail inlet.	do	1-20,000	1857-'58	J. Mechan	711
Rich inlet and Topsail sound	do	1-10,000	1857	do	617
Middle sound and Topsail sound	do	1-10,000	1857	do	618
Masonboro' inlet and Middle sound	do	1-10,000	1857	do	619
Myrtle sound	do	1-10,000	1857	do	620
Myrtle sound and Federal Point	do	1-10,000	1857	do	621
Cape Fear entrance and Smith's islands	do	1-10,000	1851-'56	Charles P. Bolles	346
Oak island, Cape Fear entrance, and Smithville.	do	1-10,000	1851	do	345
Cape Fear river, lower part, and approaches	do	1-10,000	1858	do	708

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
Cape Fear river, lower part, including New inlet.	North Carolina	1–10, 000	1858	Charles P. Bolles	709
Cape Fear river, Bay lights to Reeve's Point	....do	1–10, 000	1851–'52–'56	......do	344
Cape Feaf river, Reeve's Point to Hill Lane.	....do	1–10, 000	1853	C. P. Bolles, G. W. Gregory.	446
Cape Fear river and Campbell's island	....do	1–10, 000	1853	Charles P. Bolles	449
Cape Fear river and mouth of Brunswick creek.	....do	1–15, 000	1853	......do	447
Cape Fear river and mouth of Northwest river.	....do	1–10, 000	1853	......do	448
Cape Fear entrance, and westward	....do	1–10, 000	1852	......do	674
Lockwood Folly inlet and vicinity	....do	1–10, 000	1856	......do	673
From Lockwood Folly to Bacon's inlet	....do	1–10, 000	1857	......do	672
Winyah bay and Georgetown harbor	South Carolina	1–10, 000	1857	S. A. Wainwright, H. L. Whiting.	527
Winyah bay and Georgetown harbor	....do	1–10, 000	1857	......do..........do	526
Georgetown harbor	....do	1–20, 000	1857–'58	H. L. Whiting	834
Bull's bay	....do	1–20, 000	1857	W. S. Edwards	772
Dewes and Capers islands	....do	1–20, 000	1856–'57	Lieut. Com. J. N. Maffit	681
Part of Long island, Breach inlet to Rattlesnake inlet.	....do	1–20, 000	1854	R. M. Bache	471
Charleston harbor, north side, and Sullivan's island.	....do	1–10, 000	1849–'58	S. A. Gilbert, W. S. Edwards	262
Charleston harbor, south side to Lighthouse inlet.	....do	1–10, 000	1849	......do..........do	261
Charleston city and vicinity	....do	1–10, 000	1857–'58	W. S. Edwards	710
Morris island and vicinity	....do	1–10, 000	1858	John Seib	715
Part of Folly island	....do	1–20, 000	1849–'50	S. A. Gilbert	296
Folly island and vicinity	....do	1–20, 000	1858	John Seib	714
Morris island and Folly island	....do	1–10, 000	1864	W. H. Dennis	964
Defences of Charleston	....do	....	1865	C. O. Boutelle	976
Folly island, west end to Kiawah island	....do	1–20, 000	1854	R. M. Bache	491
Stono river, mouth of, and rebel earthworks of Cole's island.	....do	1–20, 000	1862	C. Rockwell	899
Rebel earthworks on Cole's island and fort at Old Battery, Stono river.	....do	1–10, 000 1–2, 500	1862	......do	900
North Edisto river, northeastern part	....do	1–20, 000	1851	George D. Wise	322
North Edisto river, southwestern part	....do	1–20, 000	1851	......do	327
Part of Edisto island and Jehossee island	....do	1–20, 000	1856–'57	John Seib	679
South Edisto river	....do	1–20, 000	1852	......do	508
St. Helena sound	....do	1–20, 000	1856	......do	611
Coosaw river and vicinity	....do	1–20, 000	1865	W. H. Dennis	996
Pocotaligo bridge, vicinity of	....do	1–10, 000	1865	F. W. Dorr	974
From Fripp's inlet to Port Royal sound	....do	1–20, 000	1859	J. Seib, C. Rockwell	840
Broad river, shores of	....do	1–20, 000	1865	R. E. Halter	997
Daw island, Port Royal sound	....do	1–20, 000	1859	J. Seib, C. Rockwell	839
From Port Royal sound to mouth of May river.	....do	1–20, 000	1859–'60	C. Rockwell	809
From May river to Savannah river	....do	1–20, 000	1859–'60	......do	803
From Cross Tides to head of Isla island, Savannah river.	Georgia	1–10, 000	1852	H. L. Whiting	380
Savannah river entrance to Four-mile Point	....do	1–10, 000	1852	......do	379
Savannah river, city and Elba island	....do	1–5, 000	1852	......do	383
Savannah city and environs	....do	1–10, 000	1852	......do	343
Savannah city and vicinity, (northward)	....do	1–10, 000	1852	......do	385

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
Savannah, vicinity of	Georgia	4/4 in. to 1 mile	1865	W. H. Dennis	972
Wassaw sound and vicinity	....do	1-20,000	1863	......do	906
Ossabaw sound and vicinity	....do	1-10,000	1858	A. M. Harrison	706
From Ossabaw sound to St. Catharine's sound	....do	1-20,000	1858-'59-'60	H. S. Du Val	841
Ogeechee sound and vicinity	....do	1-10,000	1858	A. M. Harrison	707
Ogeechee, Vernon, and Burnside rivers	....do	1-20,000	1865	C. Fendall	991
Wilmington river and estuaries	....do	1-20,000	1865	......do	992
Sapelo sound and vicinity	....do	1-20,000	1857-'58	A. W. Longfellow	721
Sapelo island, (reconnaissance)	....do	1-10,000	1857	H. S. Du Val	678
Blythe island and Brunswick harbor	....do	1-10,000	1856-'58	A. W. Longfellow	778
St. Simon's sound	....do	1-10,000	1856-'57	......do	750
Chickamauga battle-field	....do	1-20,000	1864	C. H. Boyd	934
St. Mary's river and vicinity	Ga. and Florida.	1-10,000	1857	A. M. Harrison	614
Cumberland island, base site, (reconnaissance.)	Georgia	1-10,000	1857	......do	624
Fernandina harbor and vicinity	Florida	1-10,000	1857	......do	613
Amelia river and vicinity	....do	1-10,000	1857	......do	615
St. John's river and Fort George inlet	....do	1-10,000	1853	R. M. Bache	411
St. John's river, from entrance to Brown's creek.	....do	1-10,000	1855	A. M. Harrison	550
St. John's river, Brown's creek to Point Suarrez.	....do	1-10,000	1855	......do	551
St. John's river, Point Suarrez to Jacksonville.	....do	1-10,000	1855-'56	......do	552
South of St. John's river, from entrance to General E. Hopkins's plantation.	....do	1-10,000	1858	J. Mechan	712
St. John's river entrance	....do	1-10,000	1864	W. H. Dennis	965
Jacksonville and vicinity	....do	1-10,000	1864	......do	963
South of St. John's river, from General Hopkins's to Diego plains.	....do	1-10,000	1858	J. Mechan	713
Diego plains	....do	1-20,000	1861	F. W. Dorr	822
North and Guano rivers, part of	....do	1-20,000	1860	......do	784
St. Augustine and vicinity	....do	1-10,000	1859-'60	......do	783
Florida peninsula, from Point Padgett to Point Andrew, (triangulation sketch.)	....do	1-69,000	1859	Captain M. L. Smith	765
Cape Cañaveral	....do	1-20,000	1850	Hull Adams	300
Indian river	....do	1-10,000	1860-'61	C. Ferguson	785
Coast of Florida, Miami river and Key Biscayne bay.	....do	1-20,000	1851	Hull Adams	336
Key Biscayne, from Shoal Point to Black Point.	....do	1-20,000	1859	C. T. Iardella	774
Key Biscayne, from Turtle Point to Fender Point.	....do	1-20,000	1859	......do	745
Cards sound, from West Arsenicker to Jew Point.	....do	1-20,000	1859	......do	746
Barnes's sound	....do	1-20,000	1859	......do	747
Barnes's sound, part of	....do	1-20,000	1859	......do	758
Cape Sable, from Palm Point to Upper Crossing.	....do	1-20,000	1857	F. W. Dorr	649
Cape Sable, from Palm Point to Northwest Cape.	....do	1-20,000	1857	......do	650
Elliott's key, Soldier key, and Ragged key	....do	1-20,000	1852-'53	Hull Adams	409
Elliott's key, Cæsar's creek, and Old Rhodes's key.	....do	1-20,000	1853	......do	408
Key Largo, Old Rhodes's to Basin Hill	....do	1-20,000	1854-'55	S. A. Wainwright	573

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
ATLANTIC COAST—Continued.					
Key Largo, Basin Hill to Excelsior	Florida	1–20,000	1855	S. A. Wainwright	574
From Egan Creek to Indian key	....do	1–20,000	1857		640
Long island, Mud and Captain key	....do	1–20,000	1857	F. W. Dorr	690
Upper Matecumb and Windley's island	....do	1–20,000	1858	C. T. Iardella	696
Buchanan and adjacent keys	....do	1–20,000	1859	......do	748
Oyster and adjacent keys	....do	1–20,000	1859	......do	749
Lower Matecumb and Lignumvitæ keys	....do	1–20,000	1857	S. A. Wainwright	641
Lower Matecumb and Long key	....do	1–20,000	1858	C. T. Iardella	694
Duck Channel and Conch keys and part of Long key.	....do	1–20,000	1857	F. W. Dorr	688
Crawl, Grassy, and Tom Harbor keys and part of Flat Deer key.	....do	1–20,000	1854	......do	689
Vaccas keys	....do	1–20,000	1857	......do	651
Bahia Honda or Spanish harbor	....do	1–20,000	1854	S. A. Wainwright	461
Bahia Honda harbor, Pine Island signal	....do	1–20,000	1851	Hull Adams	339.
Little Pine key, Johnson's Flat key, and others adjacent.	....do	1–20,000	1857	C. T. Iardella	627
Howe's key, Annette, Spanish, and others	....do	1–20,000	1857	......do	626
Big Pine key, Ramrod key, and others adjacent.	....do	1–20,000	1857	......do	625
Sugar-loaf, Cudjoe, Summerland, and Loggerhead keys.	....do	1–20,000	1856	......do	568
Content, Water, Raccoon, and Knock-em-down keys.	....do	1–20,000	1857	F. W. Dorr	652
Johnston and Sawyer's keys	....do	1–20,000	1856	S. A. Wainwright	560
Snipe and Saddle Bunch keys	....do	1–20,000	1855	Hull Adams	494
Mud keys	....do	1–20,000	1855	......do	493
Boca Chica and adjacent keys	....do	1–20,000	1853	R. M. Bache	417
Keys north and east of Boca Chica	....do	1–20,000	1853–'54	Hull Adams	457
Key West, Stock island, and adjacent keys	....do	1–10,000	1850	......do	291
Key off the harbor of Key West	....do	1–20,000	1850	......do	302
Keys and ledges, vicinity of Key West	....do	1–10,000	1850	......do	301
Marquesas key and Boca Chica	....do	1–20,000	1851	......do	319
Barnes's sound, part of	....do	1–20,000	1860	C. T. Iardella	857
GULF OF MEXICO.					
Charlotte harbor, from Boca Grande entrance to north of Boca Nueva Pass.	....do	1–20,000	1860	C. T. Iardella	853
Charlotte harbor, part of	....do	1–20,000	1860	......do	854
Charlotte harbor, from El Gabo to Peas creek.	....do	1–20,000	1863	......do	855
Peas creek, head of Charlotte harbor	....do	1–20,000	1860	......do	856
San Carlos bay and approaches	....do	1–20,000	1858	F. W. Dorr	693
Charlotte harbor, approaches	....do	1–20,000	1859	F. W. Dorr, C. Ferguson	739
Charlotte harbor, approaches	....do	1–20,000	1859	......do	738
Bayport and vicinity, (western part)	....do	1–20,000	1860	N. S. Finney	962
From Raccoon Point to Chassahowitzka river.	....do	1–20,000	1859	......do	782
From Chassahowitzka river to Homosassa river.	....do	1–20,000	1860	......do	781
From Homosassa river to Green Point	....do	1–20,000	1858–'59	......do	779
Homosassa river	....do	1–10,000	1857	......do	691
Crystal reefs and rivers	....do	1–20,000	1858	......do	705
From Crystal river to Withlacoochee bay	....do	1–20,000	1859	......do	780

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
GULF OF MEXICO—Continued.					
Withlacoochee river, (reconnaissance)	Florida	1-10,000	1856	A.M. Harrison	570
From the Waccasassa to the Withlacoochee river.	do	1-20,000	1858	N. S. Finney	699
Waccasassa reefs	do	1-10,000	1856	A. M. Harrison	571
Waccasassa river, (reconnaissance)	do	1-10,000	1856	do	569
Cedar keys and vicinity, eastward	do	1-10,000	1856	do	572
Cedar keys	do	1-10,000	1852-'54	F. H. Gerdes	423
Cedar keys	do	1-10,000	1852	do	422
Ocilla river	do	1-20,000	1854	G. D. Wise	454
From Ocilla river to St. Mark's river	do	1-20,000	1859-'60	do	819
St. Mark's river	do	1-20,000	1856	do	575
From St. Mark's river to Ocklockony bay	do	1-20,000	1859-'60	do	820
Ocklockony bay	do	1-20,000	1859	do	771
Alligator harbor and St. George's sound	do	1-20,000	1858	C. T. Iardella	695
St. George's sound from Royal bluff, including Dog island.	do	1-20,000	1858	G. D. Wise	697
From Green Point, Apalachicola bay, to East Pass, St. George's sound.	do	1-20,000	1856-'57	do	647
Delta of Apalachicola river	do	1-20,000	1857	do	648
Apalachicola river	do	1-20,000	1857	do	601
Apalachicola entrance	do	1-20,000	1858	do	646
St. Vincent sound and island	do	1-20,000	1858	do	698
St. Andrew's bay and sound	do	1-20,000	1855	do	477
Western part of Santa Rosa sound, Pensacola bay.	do	1-10,000	1859	F. H. Gerdes	701
Pensacola bay, west side	do	1-20,000	1858	do	700
Pensacola bay, entrance	do	1-10,000	1856	do	566
Pensacola bay, navy yard to Emanuel's Point.	do	1-10,000	1856	do	567
Part of Pensacola, Escambia and East bays.	do	1-20,000	1858	do	717
Santa Maria de Galvaez bay	do	1-20,000	1860	do	797
Bon Secour bay from Mullet to Cypress Point	Alabama	1-20,000	1849	W. E. Greenwell	277
Mobile bay entrance and Dauphin island	do	1-20,000	1847	do	240
Bon Secour bay, Little Point Clear to Cypress Point.	do	1-20,000	1849	do	276
Mobile bay, Mullet to Ragged Point	do	1-20,000	1849	do	286
Mobile bay, Ragged Point to Vessel Point	do	1-10,000	1849	do	294
Mobile bay, upper part	do	1-20,000	1850	do	288
Mobile city	do	1-20,000	1850	do	295
Mobile bay, Choctaw Point to Deer river	do	1-20,000	1850	do	287
Mobile river, Deer River Point to Cedar Point	do	1-20,000	1849	do	275
Dauphin Island spit	do	1-20,000	1853	do	406
Dauphin island, base line, and vicinity	do	1-10,000	1846-'51	F. H. Gerdes	326
Mississippi sound, Grand Batture to Grand Point.	Mississippi	1-20,000	1848	W. E. Greenwell, F. H. Gerdes.	243
Petit Bois island, Mississippi sound	do	1-20,000	1848	W. E. Greenwell	245
Mississippi sound, Grand Batture to West Pascagoula river.	do	1-20,000	1848	do	273
Horn island, entrance to Mississippi sound	do	1-10,000	1847	do	241
Horn island, Mississippi sound	do	1-20,000	1849	do	274
From West Pascagoula river to Biloxi bay	do	1-20,000	1851	do	323
Biloxi harbor, town and Back bay	do	1-10,000	1851	do	324
Deer island, Mississippi sound	do	1-10,000	1852		384
Ship island, Mississippi sound	do	1-20,000	1848	W. E. Greenwell	244

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Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
GULF OF MEXICO—Continued.					
Ship island, Mississippi sound	Mississippi	1-10,000	1853	W. E. Greenwell	407
Cat island and Isle au Pied	do	1-20,000	1848	do	242
From Mississippi city to Pitcher Point	do	1-20,000	1852	do	369
Harbor of Pass Christian	do	1-10,000	1851	do	325
Bay of St. Louis and town of Shieldsboro'	do	1-20,000	1852	J. M. Wampler	375
Malheureux island, Pearl river to Point Clear	do	1-20,000	1856	W. E. Greenwell	371
Pearl island and vicinity	do	1-20,000	1856	R. M. Bache	633
Approaches to Vicksburg	do	1-10,000	1863	C. Fendall	935
Approaches to Grand Gulf	do	1-5,000	1864	F. H. Gerdes	937
Mississippi sound, Isle au Pied to Nine-mile bayou.	Louisiana	1-20,000	1853	W. E. Greenwell	404
Eastern and southern shores of Lake Borgne	do	1-20,000	1853	do	405
Lake Borgne from Proctorville to Point aux Marchett.	do	1-20,000	1857	W. S. Gilbert	628
Lake Borgne from Fort Wood to Proctorville	do	1-20,000	1857	do	629
The Rigolets	do	1-20,000	1855	R. M. Bache	656
Lakes Borgne and Pontchartrain, passes connecting.	do	1-20,000	1858	W. S. Gilbert	773
Lake Pontchartrain, from Salt bayou to Bayou Bonfuca.	do	1-20,000	1859	do	774
Lake Pontchartrain, from Bayou Bonfuca to Ragged Point.	do	1-20,000	1860	M. Seaton	796
Lake Pontchartrain, from Bayou le Bar to Bayou Coushon.	do	1-20,000	1860	M. Seaton, W. S. Gilbert	799
Point aux Herbs	do	1-20,000	1859	W. S. Gilbert	786
Chandeleur sound, western shore from Sandfly to Crabtree.	do	1-20,000	1858-'59	S. Harris	768
Chandeleur sound. western shore from Barrel Key to Point Chico.	do	1-20,000	1858-'59	do	769
Chandeleur islands from Sunrise Shell Bank to Martin's island.	do	1-20,000	1857	J. E. Hilgard	654
Chandeleur islands, northern part	do	1-10,000	1852	F. H. Gerdes	366
Chandeleur islands	do	1-20,000	1855	J. E. Hilgard, J. G. Oltmanns.	548
Chandeleur islands	do	1-20,000	1855	do do	549
Pass à l'Ooutre	do	1-20,000	1859-'60	F. H. Gerdes	794
Isle Derniere, western part	do	1-10,000	1853	do	410
Atchafalaya bay, entrance	do	1-10,000	1855	do	636
Atchafalaya bay, eastern side	do	1-10,000	1855	do	637
Atchafalaya bay, eastern side	do	1-10,000	1855	do	638
Atchafalaya bay, north side	do	1-10,000	1855	do	639
Atchafalaya bay, northwest part	do	1-20,000	1857	do	632
Côte Blanche bay, eastern part	do	1-20,000	1857	do	631
West Côte Blanche bay, part of	do	1-20,000	1859	F. H. Gerdes, J. G. Oltmanns.	764
West Côte Blanche bay, part of	do	1-20,000	1860	do do	793
Fort Jackson, plan of, showing the effect of the bombardment on 18th to 24th of April, 1862.	do	1-10,000	1862	F. H. Gerdes, J. S. Harris	870
Galveston, East bay, and Bolivar peninsula	Texas	1-20,000	1851	J. M. Wampler	329
Galveston bay, Lawrence cove to Stevenson's	do	1-20,000	1851	do	330
Galveston bay, Lawrence cove to San Jacinto bay, inclusive.	do	1-20,000	1851	do	331
Galveston bay, Highland bayou to Harris's signal.	do	1-20,000	1850	do	283

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
GULF OF MEXICO—Continued.					
Redfish bar, Galveston bay	Texas	1–20,000	1850	J. M. Wampler	298
Galveston entrance, harbor, and city	....do	1–20,000	1850	......do	282
Galveston West bay, and part of Galveston island.	....do	1–20,000	1851	......do	328
Galveston West bay, Galveston island, and Chocolate bay.	....do	1–20,000	1852	......do	374
Coast of Gulf from San Luis to Jupiter station.	....do	1–20,000	1852	......do	375
From Brazos river to Matagorda peninsula	....do	1–20,000	1853	J. S. Williams, J. M. Wampler.	412
Coast and part of Matagorda bay	....do	1–20,000	1855	J. A. Sullivan	557
Matagorda peninsula and main land opposite	....do	1–20,000	1857	S. A. Gilbert	642
Matagorda bay	....do	1–20,000	1857	......do	600
Matagorda peninsula and Decros Point	....do	1–20,000	1857	......do	643
Part of Matagorda bay, from Trespalacios river to Carankaway bay.	....do	1–20,000	1856	M. Seaton	737
Matagorda bay	....do	1–20,000	1857	S. A. Gilbert	645
Lavaca bay, from Benado creek to Cox's bay	....do	1–20,000	1858	M. Seaton	742
Lavaca bay, from Garcitas bay to Chocolate bay.	....do	1–20,000	1858	......do	740
Indianola and environs	....do	1–20,000	1859	W. H. Dennis, M. Seaton	752
Matagorda and part of Espiritu Santo bay	....do	1–20,000	1857	S. A. Gilbert	644
From Matagorda entrance to Aransas Pass, (reconnaissance.)	....do	1–20,000	1858	......do	720
Espiritu Santo bay and part of San Antonio bay and vicinity.	....do	1–20,000	1859	W. H. Dennis	766
San Antonio bay, part of, and vicinity	....do	1–20,000	1859	......do	767
San Antonio bay, part of, and St. Charles bay	....do	1–20,000	1860	W. S. Gilbert	828
Aransas bay, northern part, and east end of Copano bay.	....do	1–20,000	1861	......do	838
Copano bay, west end, and St. Mary's town	....do	1–20,000	1861	......do	827
From Second Chain island to Long reef, Aransas bay.	....do	1–20,000	1860	......do	787
Aransas bay, part of, and entrance to Corpus Christi bay.	....do	1–20,000	1860–'61	......do	823
Rio Bravo del Norte entrance and vicinity	....do	1–20,000	1854	W. E. Greenwell	453
Lower part of Ohio river between Mound City and Cairo.	Illinois	1–10,000	1864	F. H. Gerdes, C. Fendal	938
Environs of St. Louis, combined sheet	Missouri	1–10,000	1862	R. M. Bache, J. Mechan	921
St. Louis, military defences of	....do	1–10,000	1862	J. Mechan	852
Vicinity and fortifications of St. Louis	....do	1–10,000	1862	R. M. Bache	908
Carondelet	....do	1–10,000	1863	......do	907
Approaches and defences of Knoxville, south of Holston river.	Tennessee	1–10,000	1863–'64	R. A. Talcott	920
Chattanooga and its approaches	....do	1–10,000	1863	F. W. Dorr	926
Nashville, approaches to, from south and west.	....do	1–10,000	1864	......do	931
Nashville, environs and approaches from the north, including the town of Edgefield.	....do	1–10,000	1864	J. W. Donn	932
Approaches and defences of Knoxville north of Holston river.	....do	1–10,000	1863–'64	C. Rockwell	939
Strawberry plains and vicinity	....do	1–10,000	1864	......do	940
Lookout valley and part of Lookout and Raccoon mountains.	....do	1–10,000	1864	J. W. Donn	966
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Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
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From southern boundary to San Diego bay	....do	1-10,000	1852	A. M. Harrison	365
San Diego bay, from La Carbonina to Sweetwater valley.	....do	1-10,000	1852	......do	364
San Diego bay, from Point Loma to Newtown	....do	1-10,000	1851	......do	333
False bay, dependency of San Diego bay	....do	1-10,000	1852	......do	363
Point Fermin to Point Pedro	....do	1-10,000	1854	W. M. Johnson	476
Coast from Point Fermin eastward to San Gabriel river.	....do	1-10,000	1859	......do	892
Coast from Hueneme eastward to Punta Mugu.	....do	1-10,000	1857	......do	893
From Hueneme Point to Santa Clara river	....do	1-10,000	1855	......do	576
From Point Duma to Cañada de Isique	....do	1-10,000	1857	......do	703
From Cañada de Isique to Punta Mugu	....do	1-10,000	1857	......do	702
From Santa Clara river to San Buenaventura	....do	1-10,000	1855	......do	683
Vicinity of Santa Barbara	....do	1-10,000	1854	......do	470
Santa Barbara and vicinity	....do	1-10,000	1852	A. M. Harrison	373
Part of the island of Santa Cruz, Santa Barbara channel.	....do	1-10,000	1859	W. M. Johnson	876
Anacapa and part of Santa Cruz island	....do	1-10,000	1855	......do	555
Point Conception, (reconnaissance)	....do	....	1850	A. M. Harrison	313
Point Pinos, Monterey bay	....do	1-10,000	1851	......do	320
Monterey harbor	....do	1-10,000	1851-'52	R. D. Cutts	357
Monterey harbor	....do	1-10,000	1854	W. M. Johnson	554
Monterey bay northward to Salinas river	....do	1-10,000	1854	......do	478
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Pajaro river and vicinity, Monterey bay	....do	1-10,000	1853	A. M. Harrison	442
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Coast from Point Pedro northward to Point Lobos.	....do	1-10,000	1853	A. M. Harrison	395
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Vicinity of Point Lobos	....do	1-10,000	1853	A. F. Rodgers	427
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Golden Gate, entrance to San Francisco bay	....do	1-10,000	1852	......do	359
San Francisco entrance	....do	1-10,000	1857	A. F. Rodgers	663
San Francisco bay entrance	....do	1-10,000	1850	R. D. Cutts	314
San Francisco city and vicinity	....do	1-10,000	1852	A. F. Rodgers	352
San Francisco city and vicinity	....do	1-10,000	1852	......do	398
San Francisco city and vicinity	....do	1-10,000	1857-'58	......do	687
Yerba Buena island, San Francisco bay	....do	1-10,000	1851	......do	353
San Francisco bay, from Cañada de Visitacion to Point San Mateo.	....do	....	1854	......do	460
Point San Mateo to Guano island, San Francisco bay.	....do	1-10,000	1853	....	433
Angelo creek to Redwood city, San Francisco bay.	....do	1-10,000	1857	A. F. Rodgers	665
Pulgas base and vicinity, San Francisco bay	....do	1-10,000	....	R. D. Cutts	432
San Francisco bay, Angelo creek to Ravenswood.	....do	1-10,000	1857	A. F. Rodgers	664

APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
PACIFIC COAST—Continued.					
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San Francisco bay, Contra Costa to Beard's creek.	do	1-10,000	1857	do	635
San Francisco bay, San Antonio creek, and Oakland.	do	1-10,000	1856	do	592
San Francisco bay, from San Antonio creek southward.	do	1-10,000	1855	do	481
San Francisco bay, Contra Costa	do	1-10,000	1852	R. D. Cutts	360
Contra Costa, San Francisco bay	do	1-10,000	1852	do	358
San Francisco bay, Contra Costa to San Antonio creek.	do	1-10,000	1856	A. F. Rodgers	591
Contra Costa, San Francisco bay	do	1-10,000	1853	A. M. Harrison	399
San Pablo bay, from Penole Point to Molate reef.	do	1-10,000	1856	A. F. Rodgers	561
San Pablo bay, from Point Wilson to Lone Tree Point.	do	1-10,000	1856	do	562
Mare island and Karquines strait, San Pablo bay.	do		1859	R. D. Cutts	316
Karquines strait, Suisun bay, and city of Benicia.	do	1-10,000	1856	A. F. Rodgers	577
Vicinity of Mare island, San Pablo bay	do	1-10,000	1856	do	563
Napa creek and city	do	1-10,000	1858	D. Kerr	777
San Pablo bay, from Long Pond to Petaluma creek.	do	1-10,000	1856	A. F. Rodgers	564
Petaluma creek, from entrance to Lakeville	do	1-10,000	1860	do	817
Petaluma creek, from Lakeville to Petaluma city.	do	1-10,000	1860	do	818
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San Francisco bay, north shore, vicinity of Bluff Point.	do	1-10,000	1853	do	415
Richardson's bay, dependency of San Francisco bay.	do	1-10,000	1851	do	334
Angel island and Raccoon straits, San Francisco bay.	do	1-10,000	1852	do	361
San Francisco bay, north side of entrance	do	1-10,000	1850	do	321
Coast northward from San Francisco entrance.	do	1-10,000	1853	do	400
Ballenas bay and vicinity	do	1-10,000	1854	do	452
Coast adjacent to Ballenas Bluff	do	1-10,000	1854	do	456
Drake's bay, from Briones to Wildcat	do	1-10,000	1859-'60	do	807
Drake's bay, from Wildcat to Point No. 1	do	1-10,000	1859-'60	do	806
Drake's bay, from Point No. 1 to Punta de los Reyes.	do	1-10,000	1859-'60	do	805
Punta de los Reyes, part of	do	1-10,000	1862	A. F. Rodgers, D. Kerr	881
Coast north of Punta de los Reyes, part of	do	1-10,000	1862	do do	882
Tomales bay, part of	do	1-10,000	1862	do do	849
Tomales bay, part of	do	1-10,000	1862	do do	880
Coast from Tomales bay to Salmon creek	do	1-10,000	1862	do do	883
Point Reyes	do	1-10,000	1852-'53	J. S. Lawson	403
Tomales bay entrance	do	1-10,000	1853-'54	do	439
Tomales bay station, (reconnaissance)	do	1-10,000	1856	C. B. Ellis	578
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APPENDIX No. 8—Continued.

Localities and limits of sheets.	State.	Scale.	Date.	Topographers.	Register number.
PACIFIC COAST—Continued.					
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Entrance to Koos bay	Oregon	1-10,000	1861	......do	846
Koos bay, sketches of	....do	1-20,000	1863	......do	927
Port Orford, or Ewing harbor	....do	1-10,000	1851	A. M. Harrison	347
Point Adams and Sand island, Columbia river.	....do	1-10,000	1851	......do	335
Columbia river entrance	....do	1-22,762	1850-'51	W. B. McMurtrie	317
Cape Disappointment	Washington T'y	1-10,000	1851	A. M. Harrison	337
Gray's harbor, part of	....do	1-20,000	1860	J. S. Lawson	821
Cape Flattery, eastward to Nee-ah bay	....do	1-10,000	1852	......do	387
Strait of Juan de Fuca, from Cape Flattery to Nee-ah bay.	....do	1-10,000	1852	......do	386
New Dungeness, strait of Juan de Fuca	....do	1-10,000	1855	......do	539
Smith's island, Rosario strait	....do	1-10,000	1855	......do	538
Strawberry bay, Cypress island, Rosario strait.	....do	1-10,000	1854	......do	462
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Part of Admiralty inlet	....do	1-10,000	1857	......do	668
Apple cove, Admiralty inlet	....do	1-20,000	1856	George Davidson, J. S. Lawson.	583
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Fauntleroy, Admiralty inlet	....do	1-10,000	1857	......do	670
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Port Townshend	....do	1-10,000	1856	......do	582
Port Townshend, Admiralty inlet	....do	1-10,000	1856	......do	581
Mats-Mats, or Boat harbor	....do	1-10,000	1855	......do	540
Port Ludlow, entrance to Hood's canal	....do	1-10,000	1855	......do	537
Entrance to Hood's canal	....do	1-10,000	1857	......do	669
Entrance to Port Gamble	....do	1-10,000	1857	......do	671
Port Gamble, entrance to Hood's canal	....do	1-10,000	1856	......do	585

APPENDIX No. 8—Continued.

List of original hydrographic sheets registered in the archives of the United States Coast Survey, geographically arranged.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Eclipse harbor, coast of Labrador		1-40,000	1860	Lieut. Comg. A. Murray	818
Line of deep-sea soundings along the coast of Labrador, from Isle of Ponds to Cape Chiddy.			1860	......do	817
Eastport harbor and approaches, No. 1, (south part.)	Maine	1-10,000	1861	C. O. Boutelle	847
Eastport harbor and approaches, No. 2, (north part.)	....do	1-10,000	1861	......do	848
Off-shore, from Machias bay to Eastern Point light.	Me., N.H., Mass.	1-300,000	1858-'59	Lieut. Comg. A. Murray	700
Penobscot bay, entrance of	Maine	1-10,000	1863	Edward Cordell	823
Rockland harbor	....do	1-10,000	1863	W. S. Edwards	819
St. George's river, No. 1	....do	1-10,000	1864	F. P. Webber	858
St. George's river, No. 2	....do	1-10,000	1864	......do	859
Coast, from Manhegan island to Damiscove Point.	....do	1-20,000	1860	Lieut. Comg. T. S. Phelps	746
Coast, between Damiscove island and Cape Small.	....do	1-40,000	1859	Lieut. Comg. J. Wilkinson	696
Damariscotta river and approaches	....do	1-10,000	1860	Lieut. Comg. J. P. Bankhead.	791
Sheepscot river, from Hendrick's Head light to Wiscasset.	....do	1-10,000	1858	Lieut. Comg. J. H. Moore	675
Sheepscot river, from Hendrick's Head light to Wiscasset.	....do	1-10,000	1858	......do	676
Mouth of Sheepscot river and Booth bay	....do	1-20,000	1860	Lieut. Comg. T. S. Phelps	771
Wiscasset bay, Back river, and Montseag bay to Westport bridge.	....do	1-10,000	1862	F. H. Gerdes	775
Hoakomoak bay, including the river emptying into the Kennebec and Sheepscot rivers.	....do	1-10,000	1862	......do	776
Merrymeeting bay and Kennebec river	....do	1-10,000	1861	......do	790
Kennebec river entrance	....do	1-20,000	1856	Lieut. Comg. S. D. Trenchard.	552
Kennebec river, northward from Bath	....do	1-10,000	1858	Lieut. Comg. J. H. Moore	693
Kennebec river, from Coxe's Head to Bath	....do	1-10,000	1857	Lieut. Comg. S. D. Trenchard.	639
Mericoneag sound	....do	1-10,000	1863	F. H. Gerdes	839
Maquoit bay, Mare Point bay, and Middle bay.	....do	1-10,000	1863	......do	840
Quohog bay	....do	1-10,000	1864	A. Strausz	857
Alden's Rock	....do	1-789	1853	Lieut. Comg. M. Woodhull	824
Casco bay	....do	1-10,000	1856	Lieut. Comg. S. D. Trenchard.	602
Casco bay	....do	1-10,000	1856	......do	614
Casco bay	....do	1-20,000	1862	E. Cordell	820
Casco bay	....do	1-40,000	1857-'58	Lieut. Comg. W. G. Temple.	664

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
From Kennebunkport to Isles of Shoals	Maine	1-40, 000	1858	Lieut. Comg. A. Murray..	667
Casco bay, lower part of..................	....do..........	1-20, 000	1861	C. A. Schott............	754
Casco bay, part of........................	....do..........	1-20, 000	1859	Lieut.Comg.J.Wilkinson.	726
Coast, from Cape Elizabeth to Kennebunkport.	....do..........	1-40, 000	1859	Lieut.Comg. A. Murray..	699
Approaches to Portland harbor............	....do..........	1-40, 000	1864	Lieut.Comg. T.S. Phelps.	860
Portland harbor, approaches, and positions of rocks.	....do..........	1-20, 000	1863	......do...............	841
Portland harbor, (outside of entrance)......	....do..........	1-20, 000	1854	Lieut.Comg.M.Woodhull	403
Portland harbor...........................	....do..........	1-10, 000	1854	......do................	404
Portland harbor additional soundings......	....do..........	1-20, 000	1862	Ed. Cordell.............	788
Rocks off Portland harbor.................	....do..........	1-20, 000	1863	Lieut.Comg.T. S. Phelps and Ed. Cordell.	796
Bank off Union wharf, Portland harbor.....	....do..........	1-5, 000	1859	Lieut.Comg.J.Wilkinson.	684
Jordan's rock, near Portland harbor........	....do..........	1-5, 000	1857	Lieut. Comg. F. A. Roe..	601
Bank off Union wharf, Portland harbor.....	....do..........	1-5, 000	1857	Lieut. Comg. S. D. Trenchard.	600
Richmond's Island harbor.................	....do..........	1-10, 000	1850	Lieut.Comg.M.Woodhull	243
York harbor..............................	....do..........	1-10, 000	1853	......do................	376
Boon island and York harbor, (outside)....	....do..........	1-20, 000	1853	......do................	366
Wood Island harbor, reconnaissance of....	....do..........	1-10, 000	1859	Lieut. Comg. A. Murray..	739
Stage Island and Cape Porpoise harbors, reconnaissance of.	....do..........	1-10, 000	1859	......do................	740
Portsmouth harbor and approaches.........	New Hampshire.	1-20, 000	1851	Lieut.Comg.M.Woodhull	294
Portsmouth to Newburyport................	N. H. and Mass.	1-20, 000	1857	Lieut. Comg. C. R. P. Rodgers.	627
Isles of shoals...........................	New Hampshire.	1-10, 000	1859	Lieut. Comg. A. Murray..	741
Jeffrey's Ledge...........................	....do..........	1-150, 000	1863	Lieut. Comg.T.S. Phelps.	861
Newburyport harbor.......................	Massachusetts..	1-10, 000	1851	Lieut.Comg.M.Woodhull	292
Cape Ann and Newburyport................	....do..........	1-20, 000	1857	Lieut. Comg. C. R. P. Rodgers.	594
Ipswich and Annisquam harbors...........	....do..........	1-10, 000	1852	Lieut.Comg.M.Woodhull	346
Annisquam and Ipswich....................	....do..........	1-20, 000	1856	Lieut. Comg. S. D. Trenchard.	574
Annisquam to Thatcher's island, (Cape Ann.)	....do..........	1-10, 000	1857	Lieut. Comg. C. R. P. Rodgers.	597
Gloucester harbor and approaches..........	....do..........	1-10, 000	1853	Lieut. Comg. H. S. Stellwagen.	396
Salem harbor and approaches..............	....do..........	1-10, 000	1850-'51	Lieut.Comg.C.H.McBlair	284
From Lynn to Marblehead..................	....do..........	1-20, 000	1853-'54	Lieut. Comg. H. S. Stellwagen.	413
Salem harbor.............................	....do..........	1-5, 000	1858	Lieut.Comg. W. G. Temple.	651
Lynn harbor..............................	....do..........	1-10, 000	1858	Lieut. Comg. A. Murray..	662
Massachusetts bay and Stellwagen's bank..	....do..........	1-80, 000	1854-'55	Lieut. Comg. H. S. Stellwagen.	516
Stellwagen's bank, Massachusetts bay.....	....do..........	1-100, 000	1854	......do................	457
Boston harbor and approaches.............	....do..........	1-20, 000	1846-'47-'48	Lieut. Comg. C.H.Davis.	221
Boston harbor, (the inner harbor)..........	....do..........	1-5, 000	1846	......do................	178

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Boston harbor, (the inner harbor,) survey under the directions of the United States Harbor Commission.	Massachusetts..	1–10,000	1861	A. Boschke............	850
Boston harbor........................	....do..........	1–10,000	1858	Lieut. Comg. W. G. Temple.	652
Shirley's Gut, Boston harbor...............	....do..........	1–5,000	1858	......do................	648
Minot's Ledge, off Boston harbor...........	....do..........	1–500	1853	Lieut. Comg. H. S. Stellwagen.	412
Stellwagen's and Cohasset Rocks, (see No. 516)	....do..........	1–10,000	1856	......do................	582
Off-shore, between Newburyport and Monomoy.	....do..........	1–300,000	1857	Lieut. Comg. C. R. P. Rodgers.	593
Philip's Ledge, Green Harbor river........	....do..........	1–40,000	1846	Lieut. Comg. C. H. Davis.	183
Plymouth harbor........................	....do..........	1–10,000	1853	Lieut. Comg. M. Woodhull	422
Cape Cod, Race Point to Nausett light.....	....do..........	1–40,000	1855–'56	Comr. H. S. Stellwagen..	519
Provincetown harbor, Cape Cod............	....do..........	1–40,000	1856	......do................	578
Cape Cod, Nausett light to Monomoy......	....do..........	1–40,000	1856	......do................	570
Barnstable harbor......................	....do..........	1–10,000	1861	H. Mitchell............	751
Part of Barnstable bay..................	....do..........	1–10,000	1860	Lieut. Comg. J. Wilkinson.	772
Phelps's bank and Asia Rip, Nantucket shoals, reconnaissance of.	....do..........	1–100,000	1860–'61	Lieut. Comg. T. S. Phelps.	745
Wellfleet harbor.......................	....do..........	1–20,000	1849–'50	Lieut. Comg. C. H. McBlair	249
Chatham harbor........................	....do..........	1–10,000	1851	Lieut. Comg. M. Woodhull	293
Monomoy shoals........................	....do..........	1–30,000	1853	......do................	387
Nantucket shoals, (Davis's south shoal)....	....do..........	1–40,000	1847–'48–'49 1850	Lieut. Comg. C. H. Davis.	223
Off Nantucket and Martha's Vineyard, (deep-sea soundings.)	....do..........	1–400,000	1853	Lieut. Comg. H. S. Stellwagen.	406
Nantucket shoals, (off-shore soundings)....	....do..........	1–300,000	1853–'54–'55	......do................	440
Nantucket shoals.......................	....do..........	1–40,000	1846	Lieut. Comg. C. H. Davis	179
Nantucket sound, (entrance).............	....do..........	1–40,000	1856	Comr. H. S. Stellwagen..	569
Nantucket sound, Noboska light to Monomoy.	....do..........	1–40,000	1854	Lieut. Comg. M. Woodhull	455
Nantucket sound........................	....do..........	1–30,000	1855–'56	Lieut. Comg. C. R. P. Rodgers.	527
Bass river.............................	....do..........	1–20,000	1849	Lieut. Comg. C. H. McBlair	245
Hyannis harbor........................	....do..........	1–20,000	1847	Lieut. Comg. J. N. Maffit.	184
Nantucket harbor.......................	....do..........	1–20,000	1846	Lieut. Comg. C. H. Davis.	181
Nantucket island, (south side)............	....do..........	1–40,000	1854	Lieut. Comg. H. S. Stellwagen.	445
Nantucket harbor, (see No. 181)...........	....do..........	1–10,000	1846	Lieut. Comg. C. H. Davis.	180
Edgartown harbor, Vineyard sound........	....do..........	1–20,000	1846	......do................	222
Naushon and vicinity....................	....do..........	1–20,000	1857	Lieut. Comg. C. R. P. Rodgers.	595
Muskeget channel and approaches.........	....do..........	1–20,000	1851	Lieut. Comg. C. H. McBlair	239
Holmes's Hole and vicinity...............	....do..........	1–10,000	1845	Lieut. Comg. G. S. Blake.	161
Martha's Vineyard, Edgartown harbor......	....do..........	1–10,000	1846	Lieut. Comg. C. H. Davis.	182
Martha's Vineyard, (south side)...........	....do..........	1–40,000	1853	Lieut. Comg. H. S. Stellwagen.	378
Lone Rock, &c., between Gay Head and No Man's Land.	....do..........	1,20,000	1852	Lieut. Comg. C. H. McBlair	344

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Cuttyhunk to Gay Head	Massachusetts	1-40,000	1857	Lieut. Comg. C. R. P. Rodgers.	596
Buzzard's bay, (eastern side)	....do	1-20,000	1845	Lieut. Comg. G. S. Blake.	160
New Bedford harbor	....do	1-20,000	1859	......do	158
Buzzard's bay, (western side)	....do	1-20,000	1845	......do	159
Buzzard's bay and Martha's Vineyard sound.	....do	1-20,000	1845-'46	Lieuts. Comg. G. S. Blake and C. H. Davis.	163
Sow and Pig's Reef, (off Cuttyhunk)	....do	1-5,000	1853	Lieut. Comg. M. Woodhull	357
Sow and Pig's Reef	....do	1-120	1853	......do	358
Sippican harbor, (sheet No. 1, west)	....do	1-5,000	1863	H. Mitchell	826
Sippican harbor, (sheet No. 2, east)	....do	1-5,000	1863	......do	829
Westport harbor, Massachusetts, and coast westward.	Mass. and R. I.	1-10,000	1844	Lieut. Comg. G. S. Blake.	155
From Mishaum Point to East Rock	Rhode Island	1-20,000	1844	......do	154
Block island, Cuttyhunk, and Gay Head, (off-shore.)	Mass. and R. I.	1-20,000	1847-'48	Lieuts. Comg. Rich. Bache and J. R. Goldsborough.	204
No Man's Land, (off-shore soundings)	....do....do	1-40,000	1851	Lieut. Comg. C. H. McBlair	238
Off Point Judith and No Man's Land	....do....do	1-100,000	1851	Lieut. Comg. S. Swartwout	283
Seekonk river	Rhode Island.	1-5,000	1865	A. M. Harrison	865
Narraganset bay	....do	1-20,000	1861	W. P. Trowbridge	792
Narraganset bay	....do	1-20,000	1862	H. Mitchell	787
Dutch Island harbor	....do	1-10,000	1862	......do	786
Coasters' harbor	....do	1-10,000	1863	H. Mitchell and F. P. Webber.	785
Newport harbor	....do	1-5,000	1865	F. P. Webber	811
Saughkonnet river and vicinity	....do	1-10,000	1848	Lieut. Comg. J. R. Goldsborough.	205
From East Rock to Point Judith	....do	1-20,000	1844	Lieut. Comg. G. S. Blake.	153
Point Judith, and eastward, (off-shore)	....do	1-20,000	1847-'48	Lieut. Comg. Rich. Bache and J. R. Goldsborough.	206
Point Judith, and southward to Block island	....do	1-40,000	1845	Lieut. Comg. G. S. Blake	162
Block Island sound, Point Judith to Quonacutog.	....do	1-20,000	1839	Lieut. Comg. T. R. Gedney	84
Block island and Fisher's island, to Quonacutog.	....do	1-20,000	1839	....	86
Additional soundings off Montauk Point, Great Eastern Rock.	....do	1-20,000	1863	Lieut. Comg. T. S. Phelps.	780
Pawcatuck river, near Stonington	Connecticut	1-10,000	....	....	98
Fisher's Island sound, (see No. 97)	....do	1-10,000	1839	Lieut. Comg. G. S. Blake.	99
Long Island sound, vicinity of Fisher's island.	....do	1-10,000	1839	......do	97
Watch Hill Reef, Block Island sound	....do	1-20,000	1847	Lieut. Comg. C. P. Patterson.	85
Fisher's Island sound.	....do	1-20,000	1839	Lieut. Comg. G. S. Blake.	96
From Gull island to Watch Hill, Long Island sound.	....do	1-10,000	1839	Lieut. Comg. T. R. Gedney	91
Thames ferry, Long Island sound	....do	1-10,000	1841	Lieut. Comg. G. S. Blake.	115
Thames ferry, from Gales's ferry to New London.	....do	1-10,000	1839	......do	114
From Black Point to New London harbor	....do	1-10,000	1839	......do	92

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
New London harbor, Long Island sound	Connecticut	1-10,000			93
Frank's Ledge, off New London harbor	do	1-10,000	1847	Lieut. Comg. Rich. Bache	94
From Griswold's to Black Point, Long Island sound.	do	1-10,000	1838	Lieut. Comg. G. S. Blake.	42
Connecticut river, (resurvey)	do	1-10,000	1849	Lieut. Comg. J. R. Goldsborough.	233
Connecticut river	do	1-10,000	1851	Lieut. Comg. M. Woodhull	276
Connecticut river bar	do	1-20,000	1851	do	275
From Fishermen's Crutch southward, Long Island sound.	do	1-10,000	1838	Lieut. Comg. G. S. Blake.	41
From Hammonasset to Cormorant Point	do	1-20,000	1838	do	39
Tuck's island, and vicinity of Madison, Long Island sound.	do	1-10,000	1838	do	38
From Bartlett to Tuck's island	do	1-10,000	1838	do	37
West Branton, and vicinity of Hoadly and Hammonasset.	do	1-20,000	1838	do	35
From Saltall to Hoadly, Long Island sound.	do	1-10,000	1838	do	34
From Oyster River Point to Saltall, abreast of New Haven.	do	1-10,000	1838	do	32
Shoal of New Haven light-house	do	1-5,000	1858	Lieut. Comg. W. G. Temple	647
Quinnipiack river at Fairhaven	do	1-10,000			33
From Stratford light-house to Indian Neck	do	1-20,000	1838	Lieut. Comg. G. S. Blake.	29
From Charles island to Oyster River Point	do	1-10,000	1838	do	28
From Black Rock to Charles island	do	1-20,000	1837	do	24
From Charles island to Black Rock	do	1-10,000	1837	do	23
Vicinity of Bridgeport, Long Island sound	do	1-5,000			25
From Sheffield Island light to Black Rock	do	1-10,000	1835	Lieut. Comg. G. S. Blake.	18
From Black Rock to Frost Point	do	1-10,000			20
From Frost Point to Sheffield Island light	do	1-10,000			19
From Sheffield light to Greenwich Point	do	1-10,000			9
From Greenwich Point to Sheffield light	do	1-10,000	1836	Lieut. Comg. G. S. Blake.	8
General chart between Gay Head and Cape Henlopen.	N. Y., N. J., and Delaware.	1-400,000	1859	A. Boschke	670
From Minursen island to Greenwich Point, Long Island sound.	New York	1-10,000	1836-'37	Lieut. Comg. G. S. Blake.	6
Montauk Point, Plum island, and vicinity	do	1-10,000	1845	Lieut. Comg. C. H. Davis	88
Plum island, Montauk Point, and vicinity	do	1-10,000			89
Gardiner's bay, Long Island sound	do	1-20,000	1838	Lieut. Comg. T. R. Gedney	80
From Fisher's island to Plum Point, Long island.	do	1-20,000	1839		87
From Race Point (Fisher's island) to Oyster Point, Long Island sound.	do	1-10,000	1839	Lieut. Comg. G. S. Blake	95
Bedford reef, (see Nos. 87, 88, and 95)	do	1-10,000	1847		90
From Plum island to Brown's hill, Long Island sound.	do	1-10,000	1838	Lieut. Comg. G. S. Blake.	43
From Brown's hill to Manor light, Long Island sound.	do	1-20,000	1838	do	40
Orient bay, Long Island sound	do	1-10,000	1839	Lieut. Comg. T. R. Gedney	81
Southhold and Orient bays, and Greenport harbor.	do	1-10,000		do	78

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Greenport harbor, Long Island sound	New York	1-10,000	1838	Lieut. Comg. T. R. Gedney	79
Sag harbor, eastern end of Long island	....do	1-10,000	1839	......do	82
Sag harbor and vicinity	....do	1-10,000	1839	......do	83
Great and Little Piconic bays, Long island	....do	1-20,000	....	......do	77
From Single Bull station to Glover, Long Island sound.	....do	1-20,000	1838	Lieut. Comg. G. S. Blake.	36
From Glover to Old Point, Long Island sound.	....do	1-20,000	1838	......do	30
From Old Point to Miller's Place, Long Island sound.	....do	1-10,000	1838	......do	31
From Old Point to Eaton Point, Long Island sound.	....do	1-20,000	1837	......do	21
From Eaton Point to Oak Neck, Long Island sound.	....do	1-10,000	....	....	10
From Smithtown to Oldfield Point, Long Island sound.	....do	1-10,000	1837	Lieut. Comg. G. S. Blake.	26
Hempstead harbor	....do	1-10,000	1859	Lieut. Comg. T. B. Huger	692
Stony Brook and vicinity, Long Island	....do	1-10,000	....	Lieut. Comg. G. S. Blake.	27
From Smithtown to Eaton Point, Long Island sound.	....do	1-10,000	1837	......do	22
Cow harbor, Long Island sound	....do	1-10,000	....	....	15
Cow harbor, Long Island sound, (see No. 15)	....do	1-3,333.3	....	....	16
Huntington harbor, Long island	....do	1-10,000	....	....	17
Oyster bay and Cold Spring harbor, Long island.	....do	1-3,333.3	....	....	14
Cold Spring harbor and Oyster bay, Long island.	....do	1-3,333.3	....	....	13
Oyster bay and Cold Spring harbor	....do	1-10,000	....	....	11
Oyster bay and Cold Spring harbor, (duplicate.)	....do	1-10,000	....	....	12
Whortleberry island to Greenwich Point, Long Island sound.	....do	1-10,000	1836-'37	Lieut. Comg. G. S. Blake.	4
From Captain's island to Whortleberry island.	....do	1-10,000	1836-'37	......do	5
From Sand's light to Matinicock, Long Island sound.	....do	1-10,000	1836-'37	......do	7
Throg's Neck and Davenport Point, Long Island sound.	....do	1-10,000	1837	......do	1
Hewlett's Point to Whortleberry island, Long Island sound.	....do	1-10,000	....	....	2
Matinicock Point and Throg's Neck, Long Island sound.	....do	1-10,000	1837	Lieut. Comg. G. S. Blake.	3
East river, Flushing bay, and vicinity	....do	1-10,000	1841	Lieut. Comg. G. M. Bache	67
Harlem river and Little Hellgate	....do	1-2,500	1849	Lieut. Comg. M. Woodhull.	225
Hellgate, (resurvey)	....do	1-2,500	1848	Lieut. Comg. D. D. Porter	224
East river, from Hellgate to Throg's Neck	....do	1-10,000	1856	Lieut. Comg. T. A. Craven.	580
Harlem river and Spuyten Duyvel creek	....do	1-10,000	1856	......do	646

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
East river, from south end of Blackwell's island to Harlem river.	New York......	1-5,000	1856	Lieut. Comg. T. A. Craven	645
Baltic Rock, New York harbor..........	....do..........	1-2,500	1861	Lieut. Comg. T. S. Phelps	748
Diamond Reef, New York harbor..........	....do..........	1-5,000	1859	Lieut. Comg. J. Wilkinson.	698
Off the Battery, New York harbor..........	....do..........	1-5,000	1859	......do..............	697
Off the Battery, New York harbor..........	....do..........	1-5,000	1859	Lieut. Comg. T. A. Craven.	678
Additional soundings in New York bay.....	....do..........	1-10,000	1863	Lieut. Comg. T. S. Phelps	783
New York harbor, (vicinity of city)........	....do..........	1-10,000	1854	Lieut. Comg. M. Woodhull.	460
From Jersey City to Williamsburg, New York harbor.	....do..........	1-10,000	1855	Lieut. Comg. T. A. Craven.	491
Communipaw flats, Gowanus bay, and Buttermilk channel.	....do..........	1-10,000	1841	Lieut. Comg. G. M. Bache	130
Diamond Reef and Prince's Reef..........	....do..........	1-2,500	1849	Lieut. Comg. M. Woodhull.	226
From Governor's island to Blackwell's island, East river.	....do..........	1-10,000	1837	Lieut. Comg. T. R. Gedney.	66
Buttermilk channel, New York bay........	....do..........	1-5,000	1848	Lieut. Comg. D. D Porter	208
Coenties Reef and Diamond Reef, New York harbor.	....do..........	1-2,000	1855	Lieut. Comg. T. A. Craven.	497
New York harbor..........................	....do..........	1-10,000	1855	......do..............	490
The Narrows, entrance to New York harbor	....do..........	1-10,000	....	Lieut. Comg. T. R. Gedney.	63
Romer and Flynn shoals and Swash channels.	....do..........	1-20,000	1853	Lieut. Comg. M. Woodhull.	356
From Fort Hamilton to Sandy Hook, New York harbor.	....do..........	1-20,000	1855	Lieut. Comg. T. A. Craven.	526
Rockaway, and vicinity of Coney island....	....do..........	1-20,000	....	....	56
Gravesend bay, and vicinity of Coney island.	....do..........	1-20,000	1841	Lieut. Comg. G. M. Bache and Lieut. Comg. Jos. C. Walsh.	59
Vicinity of Coney island and Rockaway....	....do..........	1-10,000	....	....	57
Gedney's channel, verification chart........	....do..........	....	....	....	55
Gravesend bay............................	....do..........	1-10,000	1841	Lieut. Comg. G. M. Bache.	128
South coast of Long island................	....do..........	1-40,000	1850	Lieut. Comg. M. Woodhull.	232
From Montauk Point to Quogue...........	....do..........	1-40,000	1838	Lieut. Comg. T. R. Gedney.	76
From Quogue to Montauk Point...........	....do..........	1-20,000	1838	......do..............	74
From Montauk Point to Quogue...........	....do..........	1-20,000	1838	......do..............	75
South side of Long island, vicinity of Quogue	....do..........	1-40,000	1838	......do..............	73
Vicinity of Quogue, south side of Long island.	....do..........	1-20,000	1838	......do..............	72
From Gilgo inlet to Quogue, off-shore soundings.	....do..........	1-40,000	1848	Lieut. Comg. Richard Bache.	203
From Smith's Point to Fire island, east base.	....do..........	1-20,000	1835	Lieut. Comg. T. R. Gedney.	46

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Great South bay, eastern part	New York	1-10,000	1834	Lieut. Comg. T. R. Gedney.	44
Great South bay, western part	....do	1-20,000	1834	......do	45
From Fire Island inlet, westward, south shore of Long island.	....do	1-10,000	1834-'35	......do	48
South side of Long island, from Fire island to Coney island.	....do	1-40,000	1835	......do	47
Gilgo inlet, south side of Long island	....do	1-10,000	1835	......do	49
New inlet and Great South bay	....do	1-10,000	1835	......do	50
From Rockaway to Sandy Hook, off-shore soundings.	....do	1-20,000	1835	......do	51
Rockaway inlet and part of Jamaica bay	....do	1-10,000	1841	Lieut. Comg. G. M. Bache	129
Hudson river, from Jersey City to Fort Washington.	....do	1-5,000	1837	Lieut. Comg. T. R. Gedney.	70
Hudson river, from Jersey City to Fort Washington.	....do	1-10,000	1837	......do	71
Hudson river, from Fort Washington northward.	....do	1-10,000	1855	Lieut. Comg. Richard Wainwright.	475
Hudson river, from Castle Garden northward	....do	1-10,000	1855	......do	477
Hudson river, from 60th street, New York city, to Tubby Hook.	....do	1-10,000	1855	......do	496
Hudson river, from Becker's Landing to Pollock's Point.	....do	1-5,000	1837	Lieut. Comg. T. R. Gedney.	68
Hudson river, from Becker's Landing to Pollock's Point.	....do	1-5,000	....	....	69
Hudson river	....do	1-10,000	1853	Lieut. Comg. Richard Wainwright.	408
Hudson river	....do	1-10,000	1854	......do	409
Hudson river	....do	1-10,000	1854	......do	410
Hudson river, from Toller's Point to Peekskill.	....do	1-10,000	1854	......do	458
Hudson river	....do	1-10,000	1854	......do	459
Hudson river, from Fort Montgomery to Buttermilk Hill.	....do	1-5,000	1857	Lieut. Comg. James H. Moore.	630
Hudson river, Buttermilk Hill to Stony Point	....do	1-5,000	1857	......do	631
Hudson river, Stony Point to Whortleberry	....do	1-10,000	1857	......do	632
Hudson river, from New Baltimore to Albany.	....do	1-5,000	1856	Lieut. Comg. Richard Wainwright.	549
Hudson river, from Albany to Troy	....do	1-10,000	1863	A. Strausz	843
Hudson river, from Newburg to Barnegat	....do	1-10,000	1859	Lieut. Comg. C. M. Fauntleroy.	729
Hudson river, from Barnegat to Poughkeepsie.	....do	1-10,000	1859	......do	730
Hudson river, from Poughkeepsie to Pell island.	....do	1-10,000	1860	......do	735
Hudson river, from Pell island to Rhinebeck	....do	1-10,000	1860	......do	736
Hudson river, from Rhine Cliff to Glasco	....do	1-10,000	1861	J. Mechan	752
Hudson river, from Glasco to Tivoli	....do	1-10,000	1861	......do	753
Hudson river, from Esopus creek to Puddecart Point.	....do	1-10,000	1862	......do	798

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Hudson river, from Puddecart Point to Brandon Point.	New York......	1-10,000	1862	J. Mechan	799
Hudson river, from Brandon Point to Coxsackie.	....do..........	1-10,000	1862	......do................	800
Hudson river, from Coxsackie to Houghtailing island.	....do..........	1-10,000	1863	A. Strausz	844
Rondout creek..........................	....do..........	1-5,000	1858	Lieut. Comg. A. Murray.	665
Esopus creek............................	....do..........	1-5,000	1858	......do................	666
Jersey flats, New York harbor.............	New Jersey	1-10,000	1853	Lieut. Comg. M. Woodhull.	423
Hackensack river........................	....do..........	1-10,000	1841	Lieut.Comg.G. M. Bache	131
Bar at mouth of Passaic river	....do..........	1-5,000	....	Lieut. Comg. T. R. Gedney.	65
Newark bay.............................	....do..........	1-10,000	1855	Lieut. Comg. R. Wainwright.	493
Newark bay.............................	....do..........	1-10,000	1855-'56	......do................	547
Kill van Kull............................	....do..........	1-10,000	1855	......do................	492
Newark bay, Kill van Kull, and Raritan bay.	....do..........	1-10,000	....	Lieut. Comg. T. R. Gedney.	61
Raritan bay and Newark bay..............	....do..........	1-20,000	1836	......do................	62
Staten Island sound and part of Raritan bay.	....do..........	1-10,000	1841	Lieut.Comg. G. M.Bache	127
Arthur Kill, vicinity of Elizabethport	....do..........	1-10,000	1855	Lieut. Comg. R. Wainwright.	494
Staten Island sound......................	....do..........	1-10,000	....	....	64
Arthur Kill, vicinity of Perth Amboy......	....do..........	1-10,000	1855	Lieut. Comg. R. Wainwright.	495
Raritan bay	....do..........	1-20,000	1857	Lieut. Comg. T. A. Craven.	572
Raritan bay, Amboy to Sandy Hook	....do..........	1-10,000	1841	Lieut.Comg. G. M.Bache	126
Middletown creek, Raritan bay............	....do..........	1-10,000	1841	......do................	58
Shrewsbury river........................	....do..........	1-10,000	1840	......do................	60
Shrewsbury river........................	....do..........	1-10,000	1840	......do................	107
Sandy Hook bar..........................	....do..........	1-10,000	1835	Lieut. Comg. T. R. Gedney.	52
Sandy Hook bar	....do..........	1-10,000	1835	......do................	53
Sandy Hook to Rockaway, (old and new channels.)	....do..........	1-20,000	1840	......do................	54
Sandy Hook and vicinity, (resurvey)	....do..........	1-10,000	1848	Lieut. Comg. Rich. Bache	207
Examination of False Hook...............	....do..........	1-20,000	1860	Lieut. Comg. A. Murray..	769
Sandy Point, (resurvey)	....do..........	1-5,000	1863	H. Mitchell..............	784
From Sandy Hook to Barnegat, (outer coast).	....do..........	1-40,000	1840	Lieut. Comg.T. R.Gedney	106
From Highland light to Long Branch......	....do..........	1-20,000	1840	......do................	103
From Long Branch to Barnegat...........	....do..........	1-20,000	1840	......do................	102
From Long Branch to Barnegat...........	....do..........	1-20,000	1847	......do................	113
From Long Branch to Metiticonk	....do..........	1-20,000	....	......do................	104
From Jones's to Barnegat	....do..........	1-20,000	....	......do................	105
Barnegat bay and inlet and Thomas's river .	....do..........	1-10,000	1840	Lieut. Comg. G. M. Bache	108
From Barnegat to Little Egg harbor	....do..........	1-20,000	1841	Lieut.Comg.T. R.Gedney	111
Little Egg harbor........................	....do..........	1-10,000	1840	Lieut.Comg.G. M. Bache	109

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Little Egg harbor	New Jersey	1–10,000	1840	Lieut. G. M. Bache	110
Absecom inlet	do	1–10,000	1864	Lieut. Comg. T. S. Phelps	837
From Long Branch to Cape May	do	1–40,000		Lieut. Comg. T. R. Gedney	116
Off Delaware bay	do	1–40,000		do	117
Coast of New Jersey	do	1–40,000	1847	do	112
Additional soundings off the coast of New Jersey.	do	1–200,000	1861	Lieut. Comg. T. S. Phelps	749
Back channel, League island	Pennsylvania	1–2,500	1865	E. Hergesheimer	862
Off Cape May and Cape Henlopen	Del. and N. J.	1–40,000	1844	Lieut. Comg. G. M. Bache	151
From Cape May to Montauk Point	N. Y. and N. J.	1–400,000	1842	Lieut. Comg. T. R. Gedney	100
From Cape May to Montauk Point	do	1–400,000	1842–'44–'47	do	101
Delaware bay and river, up to Trenton		1–80,000	1841–'42–'43	Lieut. Comg. G. S. Blake	148
Delaware bay and river, from Capes to Fishing creek.		1–20,000	1842–'43	do	118
Delaware bay		1–20,000	1842	do	119
Overfalls, Delaware bay, (resurvey)		1–20,000	1847	Lieut. Comg. Rich. Bache	125
Crow shoal, Delaware bay		1–10,000		Lieut. Comg. G. S. Blake.	120
Hen and Chickens shoals, (Delaware bay)		1–20,000	1847	Lieut. Comg. S. P. Lee	152
Cape May roads and Crow shoal		1–10,000	1847	Lieut. Comg. Rich. Bache	157
Delaware bay, vicinity of Fishing creek		1–10,000	1842	Lieut. Comg. G. S. Blake	123
Delaware bay, vicinity of Clark's Point		1–20,000	1842	do	122
Cohansey, Maurice, and Duck rivers		1–20,000	1843	do	121
From Egg Island light to Davis point, Delaware.		1–20,000	1841	do	124
Delaware breakwater	Delaware	1–5,000	1863	C. P. Patterson, hydrog. inspector.	801
Delaware river, from Newcastle to Reedy Point.	do	1–10,000	1861	G. Davidson	808
Dona and Mahon rivers	do	1–10,000	1852	Lieut. Comg. M. Woodhull	352
Joe Flogger shoal and Dona river		1–20,000	1852	do	299
From Ben Davis's Point to Liston's tree, Delaware bay.		1–10,000	1841	Lieut. Comg. G. S. Blake.	132
From Liston's tree to Newcastle, Delaware bay		1–10,000	1840–'41	do	133
Bulkhead shoals, (Delaware bay)		1–10,000	1846–'47	Lieuts. Comg. J. R. Goldsborough and W. P. McArthur.	156
From Newcastle to Liston's tree, (resurvey)		1–20,000	1843	Lieut. Comg. G. S. Blake.	134
From Newcastle to Dupont's wharf		1–10,000	1841	do	135
From Dupont's wharf to Newcastle, (duplicate.)		1–10,000		do	136
Christiana creek, Delaware bay		1–5,000	1841	do	137
From Dupont's wharf to Tompkins's island		1–10,000	1842	do	138
From Tompkins's island to Upper Tinicum, Delaware river.		1–10,000	1842	do	139
From Upper Tinicum to Fort Mifflin, Delaware river.		1–5,000	1842	do	140
From Fort Mifflin to Philadelphia, Delaware river.		1–10,000	1843	do	141
From Philadelphia to Bridesburg, Delaware river.		1–10,000	1843	do	142

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Delaware river, opposite Philadelphia		1-5,000	1843	Lieut. Comg. G. S. Blake.	143
From Bridesburg to Dunk's, Delaware river.		1-10,000	1844	......do	144
Delaware river, from Dunk's to Smith's		1-10,000	1844	......do	145
From Smith's to Shives's, Delaware river		1-10,000	1844	......do	146
Delaware river, from Bordentown to Trenton.		1-10,000	1844	......do	147
Off Cape Henlopen		1-200,000	1847	Lieut. Comg. S. P. Lee	189
From Cape Henlopen to Indian River inlet		1-20,000	1844	Lieut. Comg. G. M. Bache	149
Off Cape Henlopen, and southward of Cape Henry.		1-40,000	1849-'50	Lieut. Comg. T. A. Jenkins	237
Indian river and Rehoboth bay		1-20,000	1847	Lieut. Comg. Rich. Bache	150
From Indian River inlet to Beach House	Del. and Md	1-40,000	1848	Lieut. Comg. S. P. Lee	212
From Beach House station to North Birch	....do	1-40,000	1844	......do	213
Sea-coast of Maryland	Maryland	1-40,000	1850	......do	251
Winter-quarter shoal	....do	1-40,000	1863	Lieut. Comg. T. S. Phelps	761
Patuxent river, from Holland's Point, 2, to Point Jones.	....do	1-20,000	1859	Comr. W. T. Muse	704
Patuxent river	....do	1-20,000	1857	......do	641
St. Mary's river, from Point Lookout to Ford's landing.	....do	1-20,000	1857	......do	640
St. Mary's river, mouth of, and approaches.	....do	1-20,000	1859-'60	......do	701
St. Mary's river	....do	1-20,000	1859	......do	695
Little and Big Annemessia and Manokin rivers, Monic bay, and Wisconsin river.	....do	1-20,000	1858-'59	......do	707
Nanticoke river and Fishing bay	....do	1-20,000	1858	......do	673
From Cove Point to Point No-Point, and entrance to Patuxent river.	....do	1-20,000	1848	Lieut. Comg. S. P. Lee	209
Patuxent river, from entrance to St. Leonard's creek.	....do	1-20,000	1848	......do	210
Meekins's Neck and vicinity of Cove Point	....do	1-20,000	1847-'48	Lieut. Comg. W. P. McArthur.	199
Little Choptank river, Chesapeake bay	....do	1-20,000	1848	......do	200
Choptank river	....do	1-20,000	1848	......do	202
Choptank river	....do	1-20,000	1848	......do	201
Chesapeake bay, from Thomas's Point to Tilghman's island.	....do	1-20,000	1846	Lieut. Comg. S. P. Lee	188
Eastern bay and, Wye and Miles's rivers	....do	1-20,000	1847	Lieut. Comg. W. P. McArthur.	177
Annapolis harbor, Chesapeake bay	....do	1-20,000	1844	Lieut. Comg. G. M. Bache	167
Chester river, Chesapeake bay	....do	1-20,000	1846	Lieut. Comg. W. P. McArthur.	174
Chesapeake bay, from Sandy Point to Spy's Stand.	....do	1-20,000	1845	Lieut. Comg. G. M. Bache	166
Mouth of Chester river, Chesapeake bay	....do	1-20,000	1847	Lieut. Comg. W. P. McArthur.	175
Magothy river, Chesapeake bay	....do	1-10,000	1845	Lieut. Comg. G. M. Bache	164
Entrance of Patapsco river	....do	1-20,000	1854	Lieut. Comg. R. Wainwright.	415
Patapsco river, at Baltimore	....do	1-10,000	1845	Lieut. Comg. G. M. Bache	165
Patapsco river, from Rock Point to Sollers's Point.	....do	1-10,000	1852	Lieut. Comg. C. H. McBlair	339

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Belvidere shoal, Patapsco river entrance	Maryland	1-5,000 1-20,000	1852	A. Boschke	469
Gunpowder, Middle, and Back rivers	....do	1-20,000	1846	Lieut. Comg. W. P. McArthur.	169
Chesapeake bay, from Howell's Point to Pool's island.	....do	1-10,000	1846	Lieut. Comg. S. P. Lee	187
Bush river, Chesapeake bay	....do	1-20,000	1846	Lieut. Comg. W. P. McArthur.	171
Chesapeake bay, from Turkey Point to Howell's Point.	....do	1-10,000	1846	Lieut. Comg. S. P. Lee	186
Sassafras river, Chesapeake bay	....do	1-20,000	1847	Lieut. Comg. W. P. McArthur.	176
Chesapeake bay, northern part, down to Turkey Point.	....do	1-10,000	1846	Lieut. Comg. S. P. Lee	185
Elk river, Chesapeake bay	....do	1-10,000	1846	Lieut. Comg. W. P. McArthur.	172
Bohemia river and Back creek	....do	1-10,000	1846	......do	170
Northeast river, Chesapeake bay	....do	1-10,000	1846	......do	173
Susquehanna river	....do	1-10,000	1846	......do	168
Susquehanna river, (see No. 168, duplicate).	....do	1-10,000	1852		326
Eastern Branch of the Potomac, from Anacostia bridge to Benning's bridge.	District of Col	1-5,000	1865	A. Balbach	863
Eastern Branch, from Benning's bridge to Bladensburg.	D. C. and Md	1-5,000	1865	......do	864
Potomac river, from Hunter's Point to Long bridge, and Eastern Branch to Anacostia bridge.	District of Col	1-5,000	1862	Capt. C. P. Patterson, U. S. N.	764
Potomac river, from Long bridge to the Aqueduct.	....do	1-5,000	1862	......do	765
Potomac river, from Alexandria to Hunter's Point.	....do	1-10,000	1862	......do	766
Yeocomico and Cone rivers	Va. and Md	1-20,000	1860	Comr. W. T. Muse	794
Tangier sound	....do	1-40,000	1856	Lieut. J. J. Almy	557
From Point No-Point to Smith's Point light, Chesapeake bay.	....do	1-20,000	1849	Lieut. Comg. S. P. Lee	211
Chincoteague shoals and Chincoteague inlet.	Virginia	1-40,000	1851	Lieut. Comg. J. J. Almy	298
Chincoteague inlet and Chincoteague shoals.	....do	1-20,000	1851	......do	297
Wachapreague inlet and Hog Island harbor.	....do	1-40,000	1852	......do	348
Metomkin inlet	....do	1-10,000	1852	......do	349
Metomkin inlet, sea-coast of Virginia	....do	1-20,000	1862	A. M. Harrison	795
Hog Island harbor and Wachapreague inlet.	....do	1-20,000	1852	Lieut. Comg. J. J. Almy	354
Hog island and vicinity, to Cape Henry	....do	1-40,000	1853	......do	397
Sand Shoal inlet and Ship Shoal inlet	....do	1-20,000	1853	......do	388
Cape Charles and vicinity of Cherrystone inlet.	....do	1-40,000	1852-'53	......do	364
Entrance of Chesapeake bay	....do	1-20,000	1851	Lieut. Comg. B. F. Sands.	286
From Cape Henry to Mobjack bay	....do	1-40,000	1854	Lieut. Comg. J. J. Almy	446
Lynn Haven roads, Chesapeake bay	....do	1-10,000	1854	......do	449
Hampton Roads and part of Elizabeth river.	....do	1-20,000	1854	......do	447

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Norfolk harbor, Chesapeake bay	Virginia	1-10,000	1854	Lieut. Comg. J. J. Almy	448
Cape Charles and vicinity	....do	1-20,000	1852	......do	345
Cherrystone inlet, Chesapeake bay	....do	1-20,000	1852	......do	353
Chesapeake bay, from Rappahannock river to Wolf Trap.	....do	1-40,000	1851	......do	285
Hunger's creek, Chesapeake bay	....do	1-20,000	1853	......do	368
Occohannock creek and Heath's landing	....do	1-20,000	1853	......do	367
Chesapeake bay, from Potomac to Rappahannock river.	....do	1-40,000	1850	Lieuts. Comg. S. P. Lee and J. J. Almy.	252
Pungoteague creek	....do	1-20,000	1851	Lieuts.Comg. B.F.Sands and J. J. Almy.	332
Pocomoke sound	....do	1-40,000	1855	Lieut. Comg. J. J. Almy	515
Reconnaissance of White House and Lower Cedar Points, Potomac river.	....do	1-10,000	1861	Capt. W. R. Palmer	738
Potomac river, from Piney Point to Blackstone island.	....do	1-20,000	1860	Comr. W. T. Muse	793
Potomac river, from Blackstone island to Cob point.	....do	1-20,000	1862	Lieut. Comg. T. S. Phelps	827
Potomac river, from Cob Point to Mathias Point.	....do	1-20,000	1862	......do	778
Potomac river, from Mathias Point to Metomkin Point.	....do	1-20,000	1862	......do	813
Potomac river, from Metomkin Point to Shipping Point.	....do	1-20,000	1862	......do	812
Potomac river, from Shipping Point to Hallowing Point.	....do	1-20,000	1862-'63	......do	814
Potomac river, from Hallowing Point to Fort Washington.	....do	1-10,000	1863	......do	815
Potomac river, from Fort Washington to Alexandria.	....do	1-10,000	1863	......do	816
Rappahannock river entrance	....do	1-10,000	1857	Lieut. Comg. R. Wainwright.	610
Rappahannock river	....do	1-10,000	1857	......do	609
Rappahannock river	....do	1-10,000	1857	......do	608
Rappahannock and Currotoman river	....do	1-10,000	1857	......do	611
Rappahannock river	....do	1-10,000	1856	......do	607
Rappahannock river	....do	1-10,000	1856	......do	606
Rappahannock river	....do	1-10,000	1856	......do	605
Rappahannock river	....do	1-10,000	1855	......do	523
Rappahannock river	....do	1-10,000	1855	......do	522
Rappahannock river	....do	1-10,000	1855	......do	521
Rappahannock river	....do	1-10,000	1854	......do	454
Rappahannock river to Tobago bay	....do	1-10,000	1854	......do	453
Rappahannock river at Port Royal	....do	1-5,000	1854	......do	452
Rappahannock river	....do	1-5,000	1854	......do	451
Rappahannock river	....do	1-5,000	1854	......do	450
Rappahannock river	....do	1-5,000	1853-'54	......do	400
Rappahannock river	....do	1-5,000	1853-'54	......do	399

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Rappahannock river at Fredericksburg	Virginia	1-5,000	1853-'54	Lieut. Comg. R. Wainwright.	398
York river, from entrance to Bigler's mill	do	1-20,000	1857	Lieut. Comg. J. J. Almy.	583
York river, from Bigler's mill to West Point	do	1-20,000	1857	Lieut. Comg. R. D. Minor	584
James river, entrance	do	1-20,000	1854-'55	Lieut. Comg. J.N. Maffitt.	529
James river, Shoal Point to Jamestown island	do	1-20,000	1855	do	530
James river	do	1-20,000	1856	do	615
James river	do	1-10,000	1857	do	616
James river, from Little Brandon to Wyanoke wharf, (reconnaissance.)	do	1-10,000	1857	do	634
James river, from Douthard to Westover, W.	do	1-10,000	1859	Comr. W. T. Muse.	705
James river, Harrison's bar	do	1-10,000	1852	Lieut. Comg. R. Wainwright.	331
James river	do	1-5,000	1853	do	395
James river	do	1-5,000	1853	do	394
James river	do	1-5,000	1853	do	393
James river	do	1-5,000	1853	do	392
James river	do	1-5,000	1853	do	391
James river, Trent's Reach bar	do	1-5,000	1853	do	343
James river	do	1-5,000	1853	do	340
James river	do	1-5,000	1853	do	390
James river, at Warwick bar	do	1-5,000	1852-'53	do	341
James river, at Richmond	do	1-5,000	1852-'53	do	342
Appomattox river	do	1-5,000	1852	do	316
Appomattox river	do	1-5,000	1852	do	315
Appomattox river, at Petersburg	do	1-5,000	1852	do	314
Appomattox river	do	1-1,000	1851	do	279
Coast from Cape Henry southward to boundary.	do	1-40,000	1855	Lieut. Comg. J. J. Almy.	520
Soundings off False cape	do	1-40,000	1861	Lieut. Comg. T. S. Phelps	750
Off shore, from Cape Henry to Cape Hatteras.	Va. and N. C.	1-200,000	1859	Lieut. Comg. A. Murray.	674
North river, head of Currituck sound, reconnaissance of.	North Carolina	1-20,000	1859	J. Mechan	703
Currituck sound, reconnaissance of head of	do	1-20,000	1859	do	702
Currituck sound	do	1-20,000	1851	Lieut. Comg. R. Wainwright.	258
North river	do	1-20,000	1850	do	230
Pasquotank river, Albemarle sound	do	1-20,000	1847	Lieut. Comg. W. P. McArthur.	195
Little river	do	1-20,000	1848	do	197
Perquimons river	do	1-20,000	1848	do	196
Albemarle sound, Harvey's creek to Hornblow Point.	do	1-20,000	1849	Lieut. Comg. Jas. Alden.	219
Albemarle sound, Mackey's creek to Roanoke river.	do	1-20,000	1849	Lieut. Comg. T. A. Jenkins.	216
Middle, Eastmost and part of Roanoke river.	do	1-10,000	1864	J. S. Bradford	822
Batchelor's bay, Albemarle sound	do	1-10,000	1864	do	828
Scuppernong river and Bull's bay, Albemarle sound	do	1-20,000	1849	Lieut. Comg. T. A. Jenkins.	217

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Albemarle sound, Mill's Point to Pear-tree Point.	North Carolina..	1-20,000	1848	Lieut. Comg. W. P. Mc-Arthur.	198
Haulover, Albemarle sound, and vicinity of Powell's Point.	....do..........	1-20,000	1849	Lieut. Comg. Jas. Alden..	220
Alligator river, Albemarle sound...........	....do..........	1-20,000	1849	......do................	218
Albemarle, Roanoke, and Croatan sounds...	....do..........	1-20,000	1850-'51	Lieut. Comg. R. Wain-wright.	257
Croatan sound, (part of,) examination of obstructions in the same	....do..........	1-20,000	1864	J. S. Bradford	836
Pamlico sound	....do..........	1-40,000	1858	Comr. W. T. Muse.......	672
Pamlico sound...........................	....do..........	1-20,000	1857	......do................	661
Oregon inlet............................	....do..........	1-10,000	1862	H. Mitchell.............	762
Hatteras inlet..........................	....do..........	1-10,000	1861	Lieut. Comg. T. S. Phelps	763
Hatteras shoals.........................	....do..........	1-20,000	1850	Lieut. Comg. T. A. Jenkins	244
Coast from Cape Hatteras to Ocracoke inlet.	....do..........	1-40,000	1856	Lieut. Comg. J. J. Almy..	538
Hatteras inlet..........................	....do..........	1-10,000	1852	Lieut. Comg. R. Wain-wright.	322
Hatteras inlet, (reconnaissance)......	....do..........	1-5,000	1850	Lieut. Comg T. A. Jenkins	235
Hatteras inlet, (resurvey).................	....do..........	1-10,000	1857	Comr. W. T. Muse.......	612
Hatteras inlet, inner bulkhead.............	....do..........	1-10,000	1864	A. Strausz..............	612 *bis.*
Ocracoke inlet..........................	....do..........	1-10,000	1852	Lieut. Comg. R. Wain-wright.	321
Ocracoke inlet, (resurvey)....	....do..........	1-20,000	1857	Comr. W. T. Muse......	613
Neuse river.............................	....do..........	1-20,000	1863-'64	A. Strausz..............	845
The straits of North Carolina.............	....do..........	1-20,000	1864	E. Cordell..............	854
Cove sound, from the straits to Pamlico sound.	....do..........	1-40,000	1864	......do................	855
Cape Lookout Shoals, (reconnaissance).....	....do..........	1-40,000	1864	Lieut. Comg. T. S. Phelps.	849
From Cape Lookout towards Bogue sound..	....do..........	1-40,000	1857	Lieut. Comg. C. R. P. Rodgers.	577
Beaufort harbor and vicinity of Cape Lookout.	....do..........	1-10,000	1854	Lieut. Comg. J. N. Maffitt.	419
Beaufort harbor..........................	....do..........	1-10,000	1850	......do................	259
Beaufort harbor and bar..................	....do..........	1-10,000	1857	Lieut. Comg. C. R. P. Rodgers.	576
Beaufort harbor, (resurvey)...............	....do..........	1-10,000	1862	A. Boschke.............	789
Beaufort harbor, off Fort Macon...........	....do..........	1-10,000	1863	A. Strausz..............	789 *bis.*
Beaufort harbor..........................	....do..........	....	1850	Lieut. Comg. J. N. Maffitt.	246
Resurvey of entrance to Beaufort harbor....	....do..........	1-10,000	1864	Ed. Cordell	856
From Flagstaff to New River inlet....	....do..........	1-40,000	1858-'59	Lieut. Comg. A. Murray..	644
Bogue sound, from Carolina City to Beaufort.	....do..........	1-10,000	1854	Lieut. Comg. J. N. Maffitt.	418
New river and bar........................	....do..........	1-10,000	1851	......do................	280
Cape Fear river..........................	....do..........	1-5,000	1853	......do................	375
Cape Fear river	....do..........	....	1853	......do................	416
Cape Fear river..........................	....do..........	1-10,000	1853	......do................	374
New inlet, Cape Fear entrance, (resurvey)..	....do..........	1-10,000	1852	......do................	370
Cape Fear river bar.......	....do..........	....	1852	......do................	372
Cape Fear bar and New inlet..............	....do..........	1-10,000	1851	......do................	278
New Inlet bar, northern entrance of Cape Fear river.	....do..........	1-10,000	1856	......do................	618

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
New inlet, northern entrance of Cape Fear river.	North Carolina..	1-10,000	1858	Lieut. Comg. T. B. Huger.	643
Cape Fear bar	....do..........	1-10,000	1858	......do................	642
New Inlet bar, (Cape Fear)	....do..........	1-10,000	1857	Lieut. Comg. J. N. Maffitt.	621
Frying Pan Shoals	....do..........	1-20,000	1851	Lieut. Comg. T. A. Jenkins	306
Southern bars of Cape Fear river	....do..........	1-10,000	1856	Lieut. Comg. J. N. Maffitt.	619
Southern bars of Cape Fear river	....do..........	1-10,000	?57	......do................	624
Frying Pan Shoals	....do..........	1-20,000	1851	Lieut. Comg. T A. Jenkins	277
Deep-sea soundings from Cape Henry to Cape Lookout.	....	1-500,000	1860	Lieut. Comg. A. Murray..	767
Deep-sea soundings from Cape Lookout to St. Augustine.	....	1-500,000	1860	......do................	768
Off-shore, from Cape Hatteras to Cape Fear.	North Carolina.	1-200,000	1859	......do................	686
Coast from mouth of Cape Fear river to Tubb's inlet.	....do..........	1-40,000	1859	Lieut. Comg. J. P. Bankhead.	685
Deep-sea soundings between Cape Fear and Charleston harbor.	N. and S. C.....	1-300,000	1859	......do................	694
Georgetown harbor and bar	South Carolina..	1-10,000	1853	Lieut. Comg. J. N. Maffitt.	371
Winyah bay and Georgetown harbor	....do..........	1-10,000	1853	......do................	373
Cape Roman	....do..........	1-20,000	1852	Lieut. Comg. T. A. Craven	350
Georgetown bar, (resurvey)	....do..........	1-20,000	1856	Lieut. Comg. J. N. Maffitt.	533
Bull's bay	....do..........	1-20,000	1859	Lieut. Comg. J. P. Bankhead.	683
Cape Roman to Charleston	....do..........	1-40,000	1857	Lieut. Comg. J. N. Maffitt.	626
Charleston harbor and bar	....do..........	1-10,000	1851	......do................	254
Main ship bar, Charleston harbor	....do..........	1-10,000	1857	......do................	625
Maffitt's channel, Charleston harbor.	....do..........	1-10,000	1854	......do................	411
North channel and Maffitt's channel	....do..........	....	1855	......do................	476
Maffitt's channel, (resurvey)	....do..........	1-5,000	1856	......do................	532
Maffitt's channel and North channel	....do..........	1-5,000	1857	......do................	623
Charleston harbor, entrance	....do..........	1-5,000	1852	......do................	536
Resurvey of Charleston bar	....do..........	1-20,000	1863-'64	W. S. Edwards and F. P. Webber.	852
Maffitt's channel, Charleston harbor, (resurvey.)	....do..........	1-10,000	1860	Lieut. Comg. J. P. Bankhead.	718
Stono inlet and river, and part of Kiawah and Folly river.	....do..........	1-20,000	1862	C. O. Boutelle...........	803
Light-house inlet, Charleston	....do..........	1-10,000	1863-'64	......do................	853
Off-shore, between Charleston and Savannah entrance.	....do..........	1-200,000	1857	Lieut. Comg. J. N. Maffitt.	622
From Charleston to Savannah	....do..........	1-40,000	1853-'57	......do................	649
North Edisto harbor and bar	....do..........	1-20,000	1851	......do................	272
North Edisto bar	....do..........	1-20,000	1856	......do................	534
St. Helena sound and bar, South Edisto river.	....do..........	1-15,000	1856-'57	......do................	620
Inland passages, sheet No. 1, between Port Royal bay and St. Helena sound.	....do..........	1-10,000	1863	W. S. Edwards	832
Inland passages, sheet No. 2, between Port Royal bay and St. Helena sound.	....do..........	1-10,000	1863	......do................	833
Parrott creek, from Coosaw to Morgan river.	....do..........	1-10,000	1860	Lieut. Comg. J. P. Bankhead.	744

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Coosaw river, from Combahee river to Brickyard creek.	South Carolina..	1-10,000	1860	Lieut. Comg. J. P. Bankhead.	742
Brickyard creek, from Coosaw river to Beaufort.	....do..........	1-10,000	1860	......do................	743
Port Royal entrance	....do..........	1-20,000	1859	Lieut. Comg. C. M. Fauntleroy.	677
Beaufort river, (reconnaissance)...........	....do..........	1-10,000	1855	Lieut. Comg. J. N. Maffitt.	633
Port Royal entrance and Beaufort harbor...	... do..........	1-20,000	1855-'56	......do................	535
Port Royal entrance.......................	....do..........	1-20,000	1863	C. O. Boutelle...........	830
Port Royal bay and Broad river............	....do..........	1-20,000	1862-'63	......do................	831
Broad river and tributaries	....do..........	1-10,000	1865	R. E. Halter............	868
Beaufort river, from its mouth to Little Marsh island.	....do..........	1-10,000	1862	C. O. Boutelle..........	802
Beaufort river, from Marsh island to Beaufort.	....do..........	1-10,000	1862	......do................	834
Chechessee and Colleton rivers	....do..........	1-10,000	1859	Lieut. Comg. C. M. Fauntleroy.	679
Calibogue sound and part of Broad creek. ..	....do..........	1-10,000	1862	C. O. Boutelle..........	804
Skull creek................................	....do..........	1-10,000	1861-'62	......do................	805
Off-shore, between Charleston harbor and St. Andrew's sound.	S. C. and Ga ...	1-300,000	1860	Lieut. Comg. J. P. Bankhead.	728
Deep-sea soundings, between Winyah bay and Amelia island.	S. C., Ga., and Florida.	1-300,000	1858	Lieut. Comg. T. B. Huger	653
Deep-sea soundings, between Winyah bay and Amelia island, (replotted from the original notes.)	....do..........	1-300,000	1858	......do................	717
Savannah River bar	S. C. and Ga. ..	1-20,000	1854	Lieut. Comg. J. N. Maffitt.	439
Savannah River bar, (reconnaissance)......	....do..........	1-20,000	1851	......do................	269
Savannah river, entrance..................	....do..........	1-10,000	1852	......do................	317
Savannah river	....do..........	1-10,000	1850	......do................	267
Savannah river, Hutchinson's and Elba islands.	....do..........	1-5,000	1852	......do................	318
Savannah river, Front and Back rivers	....do..........	1-10,000	1851	......do................	266
Savannah river, part of Hutchinson's and Argyle islands.	....do..........	1-5,000	1852	......do................	319
Savannah river, Argyle, Onslow, and Isla islands.	....do..........	1-5,000	1852	......do................	320
Savannah river, opposite Fort Pulaski, showing the position of obstructions.	....do..........	1-10,000	1862	C. O. Boutelle	807
Lazaretto creek and part of Tybee roads ...	Georgia........	1-10,000	1863	W. S. Edwards	842
Wilmington river and estuaries............	....do..........	1-20,000	1865	C. Fendall	866
Romilly marshes	....do..........	1-5,000	1856	Lieut. Comg. J. N. Maffitt	617
Ogeechee, Vernon, and Burnside rivers.....	....do..........	1-20,000	1865	C. Fendall	867
Ossabaw sound, and Vernon and Ogeechee rivers.	....do..........	1-20,000	1860	Lieut. Comg. C. M. Fauntleroy.	733
Sapelo sound..............................	....do..........	1-10,000	1858	Lieut. Comg. J. H. Moore.	659
Sapelo sound and adjacent waters..........	....do..........	1-10,000	1858	......do................	660
Sapelo bar and approaches.................	....do..........	1-20,000	1859	Lieut. Comg. C. M. Fauntleroy.	691
Doboy bar and sound, (reconnaissance)	....do..........	1-20,000	1854	Lieut. Comg. T. A. Craven	461

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
St. Simon's entrance	Georgia	1-10,000	1856-'57	Lieut. Comg. S. D. Trenchard.	590
St. Simon's bar and Brunswick harbor	do	1-10,000	1856	do	537
St. Simon's bar and Brunswick harbor	do	1-10,000	1856	do	548
Brunswick harbor	do	1-10,000	1856	do	575
Brunswick harbor and Turtle river	do	1-10,000	1856	do	587
St. Andrew's shoal, (reconnaissance)	do	1-20,000	1850	Lieut. Comg. Jno. Rodgers	231
Soundings off the coast of Georgia	do	1-20,000	1860	Lieut. Comg. J. P. Bankhead.	810
St. Mary's bar and Fernandina harbor	Georgia and Fla.	1-10,000	1855-'56-'57	Lieut. Comg. S. D. Trenchard.	591
St. Mary's bar, (resurvey)	do	1-10,000	1857	do	571
St. Mary's bar and harbor of Fernandina	do	1-20,000	1855	Lieut. Comg. R. Wainwright.	479
St. Mary's entrance and Fernandina harbor	do	1-10,000	1855-'56-'57	Lieut. Comg. S. D. Trenchard.	579
St. Mary's river	do	1-10,000	1856	do	592
Part of St. Mary's river, up to St. Mary's	do		1856	do	550
Off-shore soundings, from Fernandina to Cape Florida.		1-400,000	1860	Lieut. Comg. A. Murray	770
St. John's river entrance, and Fort George inlet.	Florida	1-10,000	1853	Lieut. Comg. T. A. Craven	351
St. John's bar and vicinity, (current chart).	do		1855	Lieuts. Comg. R. Wainwright and S. D. Trenchard.	511
St. John's river bar, (resurvey)	do	1-10,000	1857	Lieut. Comg. S. D. Trenchard.	586
St. John's river, Mayport Mills to Brown's creek.	do	1-10,000	1855	Lieut. Comg. R. Wainwright.	481
St. John's river, Brown's creek to Six-mile creek.	do	1-10,000	1855	do	482
St. John's river, Jacksonville and vicinity	do	1-10,000	1855	do	484
St. Augustine harbor approaches	do	1-10,000	1860	Lieut. Comg. A. Murray	712
St. Augustine harbor, and North and Matanzas rivers.	do	1-10,000	1860	do	711
Mosquito inlet, (reconnaissance)	do	1-20,000	1851	Lieut. Comg. Jno. Rodgers	260
Cape Canaveral shoals, (reconnaissance)	do	1-20,000	1850	do	234
Key Biscayne and vicinity	do	1-20,000	1852	do	407
Key Biscayne and Card sound	do	1-20,000	1854	Lieut. Comg T. A. Craven	444
Florida reef, Triumph reef, and Old Rhodes bank.	do	1-20,000	1853	do	369
Pacific reef to Carysfort reef	do	1-20,000	1854	do	443
Carysfort reef to Grecian shoal	do	1-20,000	1855	do	568
Florida reef, Grecian shoal to French reef	do	1-20,000	1856	do	553
Coffins's patches, Florida reef	do	1-20,000	1854	do	417
Florida reefs, from Coffins' patches to Boot key.	do	1-20,000	1859	do	714
Florida reefs, from Bahia Honda to Key Vaccas.	do	1-20,000	1858	Lieut. Comg. W. G. Temple	663

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Florida reefs, from American shoal to Sombrero key.	Florida....	1-20,000	1857	Lieut.Comg.T.A.Craven	669
Florida reefs, from East Sambo to Loggerhead key.	....do..........	1-20,000	1856	......do................	650
Florida reefs, from Coffin's Patches to Tennessee reef.	....do..........	1-20,000	1860	Lieut.Comg. J. Wilkinson	773
Florida reefs, abreast of Upper and Lower Matacumbe keys.	....do..........	1-20,000	1862	G. Davidson	774
Florida reefs, between Alligator and French reefs.	....do..........	1-40,000	1863	E. Cordell..............	777
Additional soundings off Boca Chica........	....do..........	1-20,000	1863	......do................	779
Key West harbor and vicinity.....	....do..........	1-20,000	1851	Lieut.Comg.Jno. Rodgers	281
Key West harbor	....do..........	1-5,000	1850-'51-'52	......do................	338
Marquesas keys, and vicinity of Boca Grande.	....do..........	1-20,000	1851-'52	......do................	282
Boca Grande, Marquesas keys, and vicinity.	....do..........	1-20,000	1852	......do................	359
Rebecca shoals, (reconnaissance)	....do..........	1-10,000 1-30,000	1852	......do................	313
Charlotte harbor, main entrance...........	....do..........	1-40,000	1863	E. Cordell	797
Tampa bay, (reconnaissance).	....do..........	1-60,000	1855	Lieut. Comg. O. H. Berryman.	478
Waccasassa bay...........................	....do..........	1-20,000	1857	Lieut. Comg. J. K. Duer .	581
Waccasassa bay...........................	....do..........	1-20,000	1856	......do................	531
Cedar keys, (reconnaissance of channel, No. 4.)	....do..........	1-10,000	1852	F. H. Gerdes	304
Cedar keys	....do..........	1-20,000	1854	Lieut. Comg. O. H. Berryman.	424
Cedar keys	....do...... ...	1-20,000	1855	......do................	513
Cedar keys...............................	....do..........	1-20,000	1855	......do................	512
Cedar keys, (resurvey)....................	....do..........	1-10,000	1860	Lieut. Comg. J. J. Guthrie	713
Cedar keys, northwest channel, and Sea Horse channel bars.	....do..........	1-10,000	1860	......do................	716
Cedar keys, resurvey of Main and North keys, and southwest channels.	....do..........	1-10,000	1858-'59	Lieut. Comg. T. B. Huger	668
St. George's sound, east pass..............	....do..........	1-20,000	1858	Lieut. Comg. J. K. Duer	655
St. George's sound, west pass	....do..........	1-20,000	1858	......do................	654
Ocilla river.	....do..........	1-10,000	1855	Lieut. Comg. O. H. Berryman.	517
St. Mark's river..........................	....do..........	1-10,000	1856	......do................	541
St. Mark's river bar	....do..........	1-20,000	1856	......do................	540
St. Mark's river, bar, and channel, (reconnaissance.)	....do..........	1-20,000	1852	F. H. Gerdes...........	305
St. George's sound, St. Joseph's, and St. Mark's, (reconnaissance.)	....do..........	....	1852	......do................	307
St. George's sound, new channel..........	....do..........	1-20,000	1858-'59	Lieut. Comg. J. K. Duer.	688
St. George's sound, eastern part..........	....do..........	1-20,000	1860	Lieut.Comg.T.S. Phelps.	734
Appalachicola river, mouth of	....do..........	1-20,000	1859	Lieut. Comg. J. K. Duer.	687
Appalachicola bay	....do..........	1-20,000	1860	Lieut.Comg.T. S. Phelps.	747

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
St. Andrew's bay	Florida	1–20,000	1856	Lieut. Comg. O. H. Berryman.	518
St. Andrew's bay	do	1–20,000	1855	do	514
Santa Maria de Galvaez bay	do	1–20,000	1860	Lieut. Comg. T. S. Phelps.	731
Escambia bay	do	1–20,000	1860	do	732
Pensacola harbor, shoal spot off navy-yard.	do	1–10,000	1860	Lieut Comg. T. A. Craven.	719
Pensacola bar and bay entrance	do	1–20,000	1856	Lieut. Comg. J. K. Duer.	585
Gulf of Mexico, soundings and temperatures.			1856	Commander B. F. Sands.	528
Key West to Delta		1–120,000	1857–'58	Commander B. T. Sands.	599
Gulf of Mexico, deep-sea temperatures		1–1,200,000	1854–'55	do	483
Gulf of Mexico, deep-sea soundings and temperatures.			1855	Lieut. Comg. O. H. Berryman.	468
Mobile bay, soundings to Mississippi delta.	Alabama	1–600,000	1854	Lieut. Comg. B. F. Sands.	420
Eastward from Fort Morgan	do	1–20,000	1851	do	262
Bonsecour bay	do	1–20,000	1851	Lieut. Comg. Jas. Alden.	263
Mobile bay, lower part	do	1–20,000	1844	Lieut. Comg. C. P. Patterson.	215
Mobile bay, middle and upper part	do	1–20,000	1859	Lieut. Comg. Jas. Alden.	227
Mobile bay, upper part, and Dog river bar.	do	1–10,000	1844	Lieut. Comg. C. P. Patterson.	214
Mobile bay, delta, and Mobile city	do	1–10,000	1850	Lieut. Comg. Jas. Alden.	228
Mobile bay, upper delta	do	1–10,000	1850	do	229
Mobile bay, lower part	do	1–20,000	1848	Lieut. Comg. C. P. Patterson.	193
Mobile bay, approaches and entrance	do	1–20,000	1847–'48	do	192
Tensaw, Spanish, and Mobile rivers, and Dog River bar, (resurvey.)	do	1–10,000	1860	Lieut. Comg. J. Wilkinson.	737
Pelican channel	do	1–20,000	1855	Lieut. Comg. B. F. Sands.	467
Pelican channel, (resurvey)	do	1–20,000	1853	do	361
Horn Island channel, Mississippi sound	Mississippi	1–20,000	1846	Lieut. Comg. C. P. Patterson.	190
From Pascagoula river to east end of Horn island.	do	1–20,000	1853	Lieut. Comg. B. F. Sands.	365
Southward of Horn and Ship islands	do	1–20,000	1854	do	430
Between Horn island and Ship island, Mississippi sound.	do	1–20,000	1855	do	489
Biloxi bay	do	1–20,000	1855	do	485
Mississippi sound, from Cat island to Mississippi city.	do	1–20,000	1855	do	488
Mississippi sound, Cat and Ship islands	do	1–20,000	1848	Lieut. Comg. C. P. Patterson.	194
Mississippi sound, north of Dauphine island.	do	1–20,000	1847	do	191
From Munder's point to Grand bay, Mississippi sound.	do	1–20,000	1852	Lieut. Comg. B. F. Sands	329
Westward from Fort Morgan, Mississippi sound.	do	1–20,000	1851	do	261
Horn Island Pass	do	1–20,000	1852	do	327
Horn Island Pass, (resurvey)	do	1–20,000	1853	do	362

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
From Grand Batture to Pascagoula, Mississippi sound.	Mississippi	1-20,000	1852-'53	Lieut. Comg. B. F. Sands.	328
St. Louis bay and part of Mississippi sound	do	1-20,000	1856	Commander B. F. Sands.	546
Pass Christian	do	1-10,000	1851	do	256
Pass Christian and part of Mississippi sound, (resurvey.)	do	1-20,000	1857	do	589
Part of Chandeleur sound and Nassau roads.	Miss. and La.		1857	do	598
Grand Island Pass and Pearl river entrance.	do	1-20,000	1856	do	545
Grand Gulf	Mississippi	1-5,000	1864	F. H. Gerdes	846
Ship Island shoal	Louisiana	1-20,000	1853	Lieut. Comg. B. F. Sands.	360
Nassau roads, north of Chandeleur island	do	1-20,000	1852	do	363
Rigolets	do	1-10,000	1859	W. S. Gilbert	671
Delta of Mississippi river, (reconnaissance)	do	1-20,000	1851	Lieut. Comg. B F. Sands.	255
Southwest and South Passes, Mississippi delta.	do	1-20,000	1852	do	330
Pass à l'Outre	do	1-20,000	1860	Lieut. Comg. J. J. Guthrie.	715
Barataria harbor and bar, (reconnaissance)	do	1-10,000	1853	F. H. Gerdes	441
From Southwest Pass to Atchafalaya bay, (reconnaissance.)	do	1-20,000	1853	do	442
Atchafalaya bay	do	1-20,000	1858	Commander B. F. Sands.	658
Atchafalaya approaches	do	1-20,000	1859	Lieut. Comg. T. B. Huger.	680
Atchafalaya bay	do	1-20,000	1859	do	681
Côte Blanche bay, eastern part	do	1-20,000	1859	do	682
Vermillion bay entrance, (reconnaissance)	do	1-200,000	1855	Commander B. F. Sands.	486
Calcasieu river, (reconnaissance)	do	1-20,000	1855	do	487
Off-shore, from Timballier bay to Galveston bar.	La. and Texas	1-635,000	1858	Lieut. Comg. J. K. Duer.	657
Galveston bay, upper part, Turtle bay to Smith's Point.	Texas	1-20,000	1855	Lieut. Comg. E. J. De Haven.	470
Galveston bay, western part	do	1-20,000	1853-'54	Lieuts. Comg. H. S. Stellwagen, E. J. De Haven.	414
East Galveston bay	do	1-20,000	1854	Lieut. Comg. E. J. De Haven.	425
Off Galveston bar, and westward	do	1-20,000	1855	do	471
Galveston bar, outside and southward	do	1-20,000	1851	Lieut. Comg. T. A. Craven.	265
Galveston harbor	do	1-20,000	1851	do	264
Galveston harbor	do	1-20,000	1850	Lieut. Comg. A. S. Baldwin.	247
Galveston bay, from Bolivar point to Hanna's island.	do	1-20,000	1852	Lieut. Comg. T. A. Craven.	323
Galveston bay, from Smith's point to Edward's point.	do	1-20,000	1852	do	324
Westward of Galveston bar and Galveston island.	do	1-20,000	1855	Lieut. Comg. E. J. De Haven.	472
From Galveston island, westward	do	1-20,000	1855	do	473
San Luis Pass	do	1-10,000	1853	Lieut. Comg. H. S. Stellwagen.	389
From Velasco, westward, along the coast	do	1-20,000	1855	Lieut. Comg. E. J. De Haven.	474
Gulf coast, from Quintana westward	do	1-20,000	1856	do	539

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Localities.	State,	Scale.	Date.	Hydrographers.	Register number.
Matagorda bay, from Matagorda to Palacios.	Texas........	1-20,000	1859	Lieut. Comg. J. K. Duer.	689
Matagorda bay, northwest part	....do..........	1-20,000	1860	Lieut. Comg. W. Ronckendorff.	727
Matagorda bay entrance, Pasa del Cavallo.	....do..........	1-20,000	1858	A. Balbach	635
Brazos river bar........................	....do..........	1-10,000	1858	Lieut. Comg. J. K. Duer.	656
Aransas Pass............................	....do..........	1-10,000	1854	Lieut. Comg. H. S. Stellwagen.	386
Rio Grande river and bar, (reconnaissance).	... do..........	1-10,000	1853	Lieut. Comg. John Wilkinson.	377
Soundings in the lower Ohio river, between Cairo and Mound City.	Illinois	1-10,000	1864	F. H. Gerdes and C. Fendall.	851
Shoal southeast of San Nicolas island, (Cortez bank.)	California......	1-5,000	1853	Lieut. Comg. T. H. Stevens.	355
Cortez bank............................	....do..........	1-40,000	1856	Commander Jas. Alden..	542
Coast from San Diego to Point Conception, (reconnaissance.)	....do..........	....	1851	Lieut. Comg. Jas. Alden.	289
San Diego harbor, (reconnaissance)........	....do..........	1-10,000	1851	R. D. Cutts	268
San Diego bay and vicinity...............	....do..........	1-10,000	1856	Commander Jas. Alden..	564
San Diego bay...........................	....do..........	1-10,000	1856	......do................	565
San Diego bay...........................	....do..........	1-10,000	1856	......do................	566
San Diego bay...........................	....do..........	1-10,000	1856	......do................	567
San Clemente anchorage, southeast end of island.	....do..........	1-10,000	1856	......do................	543
San Clemente anchorage, northwest end of island.	....do..........	1-10,000	1852	Lieut. Comg. Jas. Alden.	312
Catalina island anchorage, northeast side...	....do..........	1-5,000	1852	......do................	308
Catalina harbor and anchorage, northeast side.	....do..........	1-5,000	1851	......do................	291
San Pedro and vicinity of Los Angeles.....	....do..........	1-10,000	1852	......do................	310
San Pedro anchorage......................	....do..........	1-10,000	1854	Lieut.Comg.T.H. Stevens	437
San Pedro harbor and approaches..........	....do..........	1-10,000	1859	Commander Jas. Alden..	706
Anacapa, and eastern end of Santa Cruz island.	....do..........	1-10,000	1855	......do................	501
Prisoners' harbor, Santa Cruz island.......	....do..........	1-10,000	1852	......do................	303
San Buenaventura and vicinity	....do..........	1-10,000	1855	......do................	503
Point Hueneme and vicinity, Santa Barbara channel.	....do..........	1-10,000	1856	......do................	554
Santa Cruz, (reconnaissance)	....do..........	1-10,000	1852	......do................	300
Point Conception, and vicinity of Coxo	....do..........	1-20,000	1852	......do................	295
Coast from Point Conception to San Francisco entrance.	....do..........	1-375,000	1851	......do................	290
Santa Barbara and vicinity................	....do..........	1-10,000	1852	......do................	311
Santa Barbara............................	....do..........	1-10,000	1854	Lieut.Comg T. H. Stevens	436
Cuyler's harbor, island of San Miguel......	....do..........	1-10,000	1852	Lieut. Comg. Jas. Alden.	309
San Luis Obispo and vicinity..............	....do..........	1-10,000	1852	......do................	302
San Simeon bay and vicinity..............	....do..........	1-10,000	1852	......do................	301
Coast from Point Pinos to Cape Mendocino, (reconnaissance.)	....do..........	1-1,000,000	1851	Lieut. Comg. W. P. McArthur.	241
Sanquel cove, Monterey bay	....do..........	1-10,000	1855	Lieut. Comg. Jas. Alden.	504

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Santa Cruz harbor, Monterey bay	California	1-10,000	1853	Lieut. Comg. Jas. Alden.	379
Monterey bay	do	1-20,000	1851	do	296
Monterey bay	do	1-40,000	1856	do	558
Monterey bay	do	1-10,000	1856	do	559
Monterey bay	do	1-10,000	1856	do	560
Monterey bay	do	1-10,000	1856	do	561
Williams's Landing and vicinity, Monterey bay.	do	1-10,000	1855	do	505
Williams's Landing and westward, Monterey bay.	do	1-10,000	1855	do	506
Point Año Nuevo and southward	do	1-10,000	1853	do	380
Point Año Nuevo and northward	do	1-10,000	1856	do	555
Coast northward of Pigeon Point	do	1-10,000	1856	do	556
Bodega bay, roadstead from Bodega Head to Tomales Point.	do	1-10,000	1862	B. F. Sands	806
Half Moon bay	do	1-10,000	1863	A. F. Rodgers	821
Part of the coast south of Half Moon bay	do	1-10,000	1863	do	825
Point Pedro to Half Moon bay	do	1-10,000	1863	do	835
San Francisco entrance and westward	do	1-80,000	1857	Commander Jas. Alden	562
San Francisco entrance and bar	do	1-20,000	1855	do	453
San Francisco bay, from Point Bonita to Angel island.	do	1-10,000	1855	do	462
San Francisco bay, Point Avisadera to Point Bueno.	do	1-10,000	1854	do	421
San Francisco bay, Angel island to Point Avisadera.	do	1-20,000	1855	do	464
San Francisco bay, Point Avisadera to Coyote Hill creek.	do	1-20,000	1857-'58	Comr. J. Alden and Lieut. Comg. R. M. Cuyler.	628
San Francisco bay, from Ravenswood to Coyote creek.	do	1-10,000	1857-'58	Lieut. Comg. R. M. Cuyler	636
San Francisco bay, Steinbergen and Redwood City creeks.	do	1-10,000	1858	do	637
San Francisco bay, Coyote Hill and Union City creeks.	do	1-10,000	1858	do	638
Richmond bay and Raccoon strait	do	1-10,000	1855	Commander Jas. Alden	463
San Antonio creek, San Francisco bay	do	1-10,000	1857	do	573
San Francisco bay, approaches and entrance.	do	1-100,000	1858-'59-'60	do	721
Napa creek	do	1-10,000	1860	do	723
Petaluma creek, from entrance to Lakeville.	do	1-10,000	1860	do	724
Petaluma creek, from Lakeville to Petaluma City.	do	1-10,000	1860	do	725
San Francisco bay	do	1-10,000	1857-'58	Lieut. Comg. R. M. Cuyler	629
San Francisco harbor, vicinity of city	do	1-10,000	1853	Lieut. Comg. Jas. Alden.	347
San Francisco city front, (resurvey)	do	1-10,000	1857	Lieut. Comg. R. M. Cuyler	604
San Francisco bay, from Angel island to Richmond Point.	do	1-10,000	1855	Comr. James Alden	465
San Francisco bay, from Point San Pablo to Point San Quentin.	do	1-10,000	1855	do	466
San Pablo bay	do	1-20,000	1856	do	524

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Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Channel off Point Wilson, San Pablo bay ..	California	1-20,000	1863	A. F. Rodgers	781
Part of Carquines straits	....do..........	1-20,000	1863	......do................	782
Resurvey of channel off Point Wilson, San Pablo bay.	....do..........	1-20,000	1862	Comr. B. F. Sands	758
Resurvey of approaches to Mare Island navy-yard.	....do..........	1-10,000	1862	......do................	759
Resurvey of part of Carquines straits.......	....do..........	1-10,000	1862	......do................	760
Mare Island strait, (reconnaissance).......	....do..........	1-5,000	1849	Lieut. Comg. W. P. Mc-Arthur.	288
Mare Island strait, (reconnaissance)........	....do..........	1-5,000	1850	......do................	236
Mare Island strait	....do..........	1-10,000	1856	Comr. James Alden.....	544
Mare Island strait, (resurvey)	....do..........	1-5,000	1864	Rodgers, Lawson, and Edwards.	838
Carquines strait	....do..........	1-10,000	1857	Comr. Jas. Alden.......	563
Ballenas bay and Duxbury reef............	....do..........	1-10,000	1854	Lieut. Comg. Jas. Alden.	438
Point Reyes and Drake's bay..............	....do..........	1-10,000	1854	......do................	435
Drake's bay	....do..........	1-40,000	1860	......do................	720
Tomales bay, entrance and part of.........	....do..........	1-10,000	1861	Comr. B. F. Sands......	756
Tomales bay, from Tom's Point to head of navigation.	....do..........	1-10,000	1861	......do................	757
Coast from San Francisco to Crescent City..	....do..........	....	1854	Lieut. Comg. Jas. Alden .	401
Mendocino city harbor, (reconnaissance)....	....do..........	1-10,000	1853	......do................	384
Shelter cove, (reconnaissance)............	....do..........	1-10,000	1853	......do................	385
Humboldt bay, entrance and part of	....do..........	1-10,000	1859	......do................	710
Humboldt bay	....do..........	1-10,000	1851	......do................	270
Humboldt bay	....do..........	1-10,000	1851	......do................	271
Trinidad bay	....do..........	1-5,000	1851	......do................	274
Crescent City harbor and approaches.......	....do..........	1-10,000	1859	......do................	690
Crescent City harbor, (resurvey)	....do..........	1-10,000	1855	......do................	480
Crescent City harbor	....do..........	1-10,000	1853	......do................	383
Coast from False Klamath to Columbia river.	....	....	1854	......do................	402
Coast from Table bluff to Coquille river	Oregon	....	1850	Lieut. Comg. W. P. Mc-Arthur.	242
Coast from Umpquah head to Columbia river.	....do..........	....	1851	......do................	240
Coquille river, reconnaissance of, entrance and part of.	....do..........	1-10,000	1860	Comr. James Alden.....	722
Koos bay entrance and part of	....do..........	1-10,000	1861	J. S. Lawson...........	755
Port Orford, or Ewing harbor	....do..........	1-10,000	1853	Lieut. Comg. Jas. Alden.	381
Umpquah river entrance...................	....do..........	1-10,000	1853	......do................	382
Coast from Columbia river to Point Grenville.	....do..........	....	1852	......do................	334
Coast from Columbia river to Admiralty inlet.	....do..........	....	1852	......do................	333
Columbia river, (entrance)................	....do..........	1-20,000	1851	Lieut. Comg. W. P. Mc-Arthur.	273
Columbia river, (entrance)................	....do..........	1-20,000	1854	Lieut. Comg. Jas. Alden .	428
South channel bar, mouth of Columbia river.	....do..........	1-10,000	1854	......do................	429
Columbia river, (entrance)................	....do..........	1-20,000	1852	......do................	336
Columbia river, (entrance)	....do..........	1-20,000	1850	Lieut. Comg. W. P. Mc-Arthur.	250

APPENDIX No. 8—Continued.

Localities.	State.	Scale.	Date.	Hydrographers.	Register number.
Shoalwater bay	Washington Ter.	1-18,818	1855	Comr. James Alden	498
Shoalwater bay	....do	1-20,000	1852	......do	335
Entrance and part of Gray's harbor	....do	1-20,000	1862	J. S. Lawson	809
Grenville harbor	....do	1-10,000	1854	Lieut. Comg. Jas. Alden.	426
Coast from Columbia river to Cape Flattery.	....do	....	1852	......do	427
Neé-ah harbor, straits of Juan de Fuca	....do	1-10,000	1852	......do	337
False Dungeness, straits of Juan de Fuca	....do	1-10,000	1852	......do	325
False Dungeness, straits of Juan de Fuca	....do	1-10,000	1855	......do	500
Port Townshend	....do	1-10,000	1854	......do	434
Port Ludlow, entrance of Hood's canal.	....do	1-10,000	1855	......do	508
Admiralty inlet	....do	1-100,000	1855	......do	510
Port Gamble, entrance of Hood's canal	....do	1-10,000	1855	......do	509
Blakely harbor	....do	1-10,000	1856	......do	525
Duwamish bay	....do	1-10,000	1854	......do	432
Steilacoom harbor and vicinity of Puget's sound.	....do	1-10,000	1855	......do	499
Olympia harbor, Puget's sound	....do	1-10,000	1855	......do	507
Rosario and Haro straits	....do	1-100,000	1854	......do	433
Gulf of Georgia, part of, and entrance to Haro and Rosario straits.	....do	1-100,000	1858-'59	......do	709
Haro and Rosario straits, entrance	....do	1-20,000	1858	......do	708
Haro and Rosario straits, near Vancouver's island.	....do	....	1853	......do	405
Smith's or Blunt's island, Rosario straits	....do	1-10,000	1854	......do	431
Bellingham bay	....do	1-20,000	1855	......do	502
Semi-ah-moo bay	....do	1-20,000	1857	Lieut. Comg. R.M. Cuyler	603

APPENDIX No. 9.

LIST OF GEOGRAPHICAL POSITIONS IN SECTIONS V, VI, VII, AND IX, DETERMINED BY THE UNITED STATES COAST SURVEY, AND CONTINUED FROM ANNUAL REPORT OF 1864, APPENDIX No. 15.

The present list is a continuation of that published in last year's report, and contains the geographical positions in the southern sections determined since the publication of such positions in my report of 1859, Appendix No. 20. A full explanation of the object and use of geographical positions having been given in preceding reports, (1851, 1853, 1855, 1857, 1859, and 1864,) I insert here only so much of the general preface as is necessary for their immediate use.

The longitude of Cambridge, Harvard observatory, as adopted in former reports, (since 1851,) viz: 4^h 44^m. 29.50^s., or 71° 07′ 22.50″, is still retained for uniformity's sake, although from later discussions it would seem to bear an increase ot about three-quarters of a second of time.

In section V the longitudes depend on the telegraphic determination of Wilmington, viz: St. James Episcopal church—77° 56′ 32.6″. Also on the telegraphic determination of Charleston, viz: Gibbes's observatory—79° 56′ 00.0″.

NOTE.—The latitudes of positions, Cape Fear river, 1855 report, p. 135, require an increase of about 0.74″ due to additional astronomical observations. The latitudes of positions on the coast of South Carolina, 1857 report, pp. 280, 287, require an increase of about 1.36″, due to the junction of the Charleston and Savannah series of triangles. The latitudes of positions, Savannah river to Sapelo sound, 1859 report, pp. 245, 253, require a diminution of about 1.66″, and the longitude of the same positions a diminution of about 1.80″ for the same reason as above—the longitudes now depend upon that of Charleston.

In Section VI the longitudes depend on those of the preceding section; also upon the longitude of Cape Florida, from moon culminations, viz: 80° 09′ 24.0″. Also upon the longitude of Section VII, Depot Key, Cedar Keys, viz: 83° 02′ 45.0″.

NOTE.—The longitudes of positions, vicinity of St. Mary's river, 1859 report, pp. 257, 259, require a diminution of 6.85″, due to the junction with preceding section.

In Section VII the longitudes depend also on the telegraphic longitude of Apalachicola, viz: 84° 58′ 58.91″.

The approximate longitude of Pensacola, flag-staff, public square, from telegraphic determinations, is 87° 12′ 44″.

NOTE.—The positions of St. Mark's harbor, 1857 report, p. 291, are superseded by the positions now given.

In Section IX the longitudes depend on Dollar Point, viz: 94° 53′ 00″.

Explanation of the tables.—The first column contains the name of the station; the sketches showing the configuration of the land and the relative positions of the trigonometrical points; no great difficulty will be experienced in finding the latter, when desired for local surveys or reference. In any case where minute descriptions of particular points are required, they can be had by application to the Coast Survey office. The second and third columns contain the geodetic latitudes and longitudes; the fourth column the azimuth to the station named in the fifth column, or the angle which a line to the latter station makes with the south meridian, counted in the directions S., W., N., &c., to 360 degrees; the sixth column gives the reverse azimuth, or the angle with the south meridian of the line directed to the station in the first column; the difference between these azimuths is 180°, less the inclination of the meridians passing through the two stations. The remaining three columns give the distances between the stations in the first and fifth columns, expressed in metres, yards, and statute miles.

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section V.—Cape Fear, westward.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Cape Fear base, north end, 1853	33 54 28.83	77 56 21.46						
Cape Fear base, south end, 1851	33 52 28.33	77 56 42.48	188 16 31	North base, 1853	8 16 43	3751.4	4102.4	2.33
Fort Johnson Flagstaff	33 54 57.95	78 00 48.17	277 26 25	North base, 1853	97 28 54	6909.0	7555.4	4.29
			306 07 17	South base, 1851	126 09 34	7815.8	8547.1	4.86
South Caswell	33 53 26.89	78 00 48.06	254 24 38	North base, 1853	74 27 07	7109.5	7774.8	4.42
			179 56 27	Fort Johnson Flagstaff	359 56 27	2805.3	3067.8	1.74
Smithville	33 54 57.84	78 00 47.90	116 08 46	Fort Johnson Flagstaff	296 08 46	7.7	8.4	0.00
			0 04 57	South Caswell	180 04 57	2801.9	3064.1	1.74
Three Cedars	33 53 32.63	77 59 04.48	86 12 43	South Caswell	266 11 45	2667.0	2916.5	1.66
			134 40 00	Smithville	314 39 02	3735.0	4084.5	2.32
North, 1855	33 54 28.84	77 56 21.74	74 26 00	South Caswell	254 23 33	7102.9	7767.5	4.41
			97 27 56	Smithville	277 25 27	6894.8	7539.9	4.28
South, 1855	33 52 28.37	77 56 43.06	106 00 04	South Caswell	285 57 47	6548.5	7161.2	4.07
			188 23 30	North, 1855	8 23 42	3751.7	4102.8	2.33
New North	33 54 41.13	77 56 23.68	94 21 37	Smithville	274 19 09	6806.2	7443.1	4.23
			62 57 01	Three Cedars	242 55 31	4638.3	5072.3	2.88
New South	33 52 51.92	77 56 40.40	187 16 32	New North	7 16 41	3391.9	3709.3	2.11
			108 43 55	Three Cedars	288 42 35	3908.3	4274.0	2.43
New McRacken	33 57 01.91	77 58 48.58	319 21 41	New North	139 23 02	5714.6	6249.3	3.55
			3 37 24	Three Cedars	183 37 15	6460.3	7064.8	4.01
Sand Point	33 57 29.57	77 56 06.96	78 24 13	New McRacken	258 22 43	4235.9	4632.3	2.63
			4 43 52	New North	184 43 43	5207.2	5694.5	3.24
Driftwood	33 58 54.01	77 57 11.45	327 31 35	Sand Point	147 32 11	3083.5	3372.0	1.92
			35 49 53	New McRacken	215 48 59	4259.8	4658.4	2.65
Peter's Point	33 59 24.83	77 55 12.00	72 47 45	Driftwood	252 46 38	3209.3	3509.6	1.99
			21 40 07	Sand Point	201 39 36	3821.2	4178.7	2.37
Newton	33 59 56.74	77 57 07.42	288 21 02	Peter's Point	108 22 06	3120.6	3412.6	1.94
			3 03 54	Driftwood	183 03 52	1935.4	2116.5	1.20
North Caswell	33 53 30.04	78 00 49.08	268 17 28	Three Cedars	88 18 26	2688.7	2940.3	1.67
			180 38 39	Smithville	0 38 39	2705.2	2958.3	1.68
Bald Head	33 52 05.29	78 00 08.77	169 17 37	Smithville	349 17 15	5410.2	5916.4	3.36
			211 32 42	Three Cedars	31 33 18	3157.5	3452.9	1.96
Court-House	33 55 02.44	78 00 52.29	348 25 07	Bald Head	168 25 31	5571.3	6092.6	3.46
			358 20 33	North Caswell	178 20 35	2847.9	3114.3	1.77
Oak Island	33 53 38.19	78 02 56.14	276 01 28	South Caswell	96 02 39	3309.0	3618.6	2.06
			274 23 18	North Caswell	94 24 29	3273.9	3580.3	2.03
Dosher 1	33 55 04.72	78 02 47.25	4 53 43	Oak Island	184 53 38	2675.8	2926.2	1.66
			314 32 11	South Caswell	134 33 17	4296.2	4698.2	2.67
Uncle Sam 5	33 54 05.15	78 04 46.68	239 06 05	Dosher 1	59 07 12	3574.6	3909.0	2.22
			280 51 42	South Caswell	100 53 55	6242.5	6826.6	3.88
Smith	33 55 18.30	78 04 50.79	277 30 05	Dosher 1	97 31 14	3200.4	3499.9	1.99
			357 18 54	Uncle Sam 5	177 18 56	2256.0	2467.1	1.40
High Ridge	33 54 24.04	78 06 27.16	235 57 45	Smith	55 58 39	2986.9	3266.4	1.86
			282 41 50	Uncle Sam 5	102 42 46	2646.1	2893.7	1.64
Ash Swamp 1	33 55 07.29	78 06 15.59	309 57 42	Uncle Sam 5	129 58 32	2980.2	3259.0	1,85
			12 34 28	High Ridge	192 34 22	1365.2	1492.9	0.85
Hoxney	33 54 39.18	78 07 56.53	251 31 17	Ash Swamp 1	71 32 13	2733.4	2989.1	1.70
			281 28 54	High Ridge	101 29 44	2342.2	2561.3	1.46
Ash Swamp 2	33 55 22.29	78 07 45.32	12 13 44	Hoxney	192 13 38	1359.0	1486.2	0.84
			311 47 38	High Ridge	131 48 22	2692.5	2944.4	1.67
Cedar Top	33 54 43.75	78 09 02.53	274 44 30	Hoxney	94 45 07	1701.3	1860.5	1.06
			239 05 01	Ash Swamp 2	59 05 44	2311.4	2527.6	1.44
Swain	33 55 35.92	78 08 57.33	4 45 15	Cedar Top	184 45 12	1612.8	1763.8	1.00
			318 13 10	Hoxney	138 13 44	2344.0	2563.3	1.46
Pilot Hill	33 54 47.16	78 10 08.54	273 32 41	Cedar Top	93 33 18	1698.7	1857.6	1.06
			230 36 00	Swain	50 36 40	2366.8	2588.2	1.47
Rattlesnake	33 55 51.92	78 10 45.88	334 19 29	Pilot Hill	154 19 50	2213.4	2420.5	1.38
			280 01 01	Swain	100 02 02	2830.9	3095.8	1.76

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section V.—Cape Fear, westward.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Big Hill	33 54 47.26	78 11 54.87	221 39 09	Rattlesnake	41 39 48	2666.0	2915.5	1.66
			270 03 22	Pilot Hill	90 04 21	2731.2	2986.8	1.70
Wortham	33 55 03.49	78 01 58.26	271 05 18	Court-House	91 05 55	1694.7	1853.3	1.05
			29 30 22	Oak Island	209 29 50	3019.4	3301.9	1.88
Jenkins, (tripod)	33 53 22.44	78 01 41.21	204 58 42	Smithville	24 59 12	3242.5	3545.9	2.01
			171 59 33	Wortham	351 59 24	3144.0	3438.2	1.95
Spencer	33 55 39.78	78 02 49.35	322 17 31	North Caswell	142 18 38	5051.8	5524.5	3.14
			2 39 56	Oak Island	182 39 52	3750.2	4101.1	2.33
Reeves	33 55 23.02	78 02 22.30	126 37 04	Spencer	306 36 49	865.7	946.7	0.54
			15 03 59	Oak Island	195 03 40	3344.7	3657.6	2.08
Dosher 2	33 55 07.92	78 02 41.90	276 56 14	Wortham	96 56 38	1129.4	1235.1	0.70
			227 15 45	Reeves	47 15 56	685.5	749.6	0.43
Dutchman	33 55 35.53	78 03 05.08	252 03 18	Spencer	72 03 27	424.7	464.4	0.26
			325 01 11	Dosher 2	145 01 24	1038.1	1135.3	0.65
Mathews	33 56 04.02	78 03 06.70	357 17 02	Dutchman	177 17 03	878.6	960.8	0.55
			329 10 15	Spencer	149 10 25	869.6	951.0	0.54
Vann	33 55 59.90	78 02 34.27	98 39 11	Mathews	278 38 53	842.5	921.3	0.52
			46 30 25	Dutchman	226 30 08	1090.9	1193.0	0.68
Uncle Sam 1	33 54 26.11	78 03 19.94	253 32 49	Court-House	73 34 11	3954.0	4324.0	2.46
			215 12 38	Dosher 1	35 12 56	1456.0	1592.3	0.90
Uncle Sam 2	33 54 37.40	78 03 53.15	243 33 15	Dosher 1	63 33 52	1890.2	2067.0	1.17
			130 24 08	Smith	310 23 36	1944.2	2126.1	1.21
Barnes' Bluff, flag	33 55 15.01	78 03 56.19	280 08 31	Dosher 1	100 09 09	1798.7	1967.0	1.12
			94 08 08	Smith	274 07 38	1406.1	1537.7	0.87
Uncle Sam 3	33 54 44.32	78 04 37.66	162 08 39	Smith	342 08 32	1099.8	1202.7	0.68
			280 33 35	Uncle Sam 2	100 34 00	1163.0	1271.8	0.72
Galloway	33 54 56.92	78 05 25.41	233 28 46	Smith	53 29 05	1106.4	1209.9	0.69
			287 33 57	Uncle Sam 3	107 34 24	1286.7	1407.1	0.80
Sellers	33 55 26.54	78 05 49.21	326 10 45	Galloway	146 10 58	1098.1	1200.9	0.68
			305 17 07	Uncle Sam 3	125 17 47	2251.4	2462.0	1.40
Hickory Point	33 55 28.52	78 06 03.85	279 14 14	Sellers	99 14 22	380.7	416.4	0.24
			279 31 23	Smith	99 32 04	1902.8	2080.9	1.18
Hog Bluff	33 55 00.04	78 05 41.01	146 14 25	Hickory Point	326 14 12	1054.9	1153.7	0.66
			165 31 42	Sellers	345 31 37	843.4	922.3	0.52
Marsh Signal	33 55 25.54	78 06 19.19	256 51 52	Hickory Point	76 52 01	404.5	442.3	0.25
			267 41 56	Sellers	87 42 13	770.7	842.8	0.48
Galloway's Hill	33 55 51.16	78 06 02.66	28 16 27	Marsh Signal	208 16 18	896.2	980.1	0.56
			2 30 33	Hickory Point	182 30 32	698.0	763.3	0.43
St. Helena Sound to Port Royal Sound.								
ASHEPOO	32 32 44.28	80 28 37.09	....	....	....	....	....	.....
WEST BASE	32 30 28.67	80 19 21.15	106 06 16	Ashepoo	286 01 17	15095.9	16508.3	9.38
Coffin	32 24 26.49	80 24 47.48	217 21 02	West Base	37 23 57	14038.0	15351.5	8.72
			158 39 43	Ashepoo	338 37 40	16462.9	18003.4	10.23
Church	32 26 04.58	80 40 10.20	235 42 55	Ashepoo	55 49 07	21884.4	23932.1	13.60
			277 04 31	Coffin	97 12 46	24294.1	26567.3	15.10
Port Royal	32 17 45.60	80 38 22.93	239 51 42	Coffin	59 58 59	24636.9	26942.2	15.31
			169 40 05	Church	349 39 08	15622.4	17084.1	9.71
Otter Island	32 28 28.82	80 24 35.45	245 45 04	West Base	65 47 53	8996.7	9838.5	5.59
			2 24 36	Coffin	182 24 29	7470.7	8169.8	4.64
Morgan	32 27 49.98	80 28 27.99	258 50 09	Otter Island	78 52 14	6188.4	6767.5	3.85
			317 24 06	Coffin	137 26 04	8512.3	9308.8	5.29
Hutchinson	32 29 47.07	80 28 16.87	292 37 06	Otter Island	112 39 05	6262.7	6848.7	3.89
			4 36 11	Morgan	184 36 05	3618.2	3956.8	2.25
Cruger	32 26 43.34	80 28 34.35	242 28 23	Otter Island	62 30 31	7033.6	7691.7	4.37
			184 37 37	Morgan	4 37 40	2059.0	2251.6	1.28
Hangman 2	32 30 47.13	80 31 11.14	292 07 06	Hutchinson	112 08 40	4910.2	5369.6	3.05
			322 00 52	Morgan	142 02 20	6921.8	7569.5	4.30

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section V.—St. Helena Sound to Port Royal Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Parrott	32 28 25.24	80 32 22.32	248 30 37	Hutchinson	68 32 49	6885.6	7529.9	4.28
			280 03 00	Morgan	100 05 06	6214.3	6795.8	3.86
Palmetto	32 27 06.96	80 31 59.03	256 28 06	Morgan	76 29 59	5668.2	6198.6	3.52
			277 44 07	Cruger	97 45 57	5394.5	5899.3	3.35
Barnwell	32 29 11.67	80 34 08.52	297 16 28	Parrott	117 17 25	3119.8	3411.7	1.94
			263 12 00	Hutchinson	83 15 09	9244.1	10109.1	5.74
Bull	32 31 09.40	80 34 21.68	328 21 03	Parrott	148 22 07	5939.1	6494.9	3.69
			284 53 15	Hutchinson	104 56 31	9853.2	10775.2	6.12
Beef Island Pine	32 31 52.57	80 30 03.85	41 03 58	Hangman 2	221 03 22	2673.3	2923.4	1.66
			78 50 25	Bull	258 48 06	6857.9	7499.6	4.26
Marsh Signal	32 29 33.55	80 30 00.27	200 16 22	Ashepoo	20 17 07	6263.0	6849.0	3.89
			322 55 40	Morgan	142 56 30	3997.5	4371.5	2.48
Hunting Island Light-house, chimney.	32 24 15.69	80 24 45.36	138 38 03	Morgan	318 36 04	8796.3	9619.4	5.47
			181 54 07	Otter Island	1 54 12	7800.6	8530.5	4.85
Mrs. March's Chapel	32 32 29.41	80 28 45.36	205 12 24	Ashepoo	25 12 28	506.0	553.4	0.31
			50 22 42	Hangman 2	230 21 23	4939.0	5401.1	3.07
Bythewood	32 30 39.83	80 29 56.61	208 25 10	Ashepoo	28 25 53	4359.0	4766.9	2.71
			96 35 13	Hangman 2	276 34 33	1958.1	2141.4	1.22
Squat	32 30 12.83	80 33 06.78	340 41 33	Parrott	160 41 57	3511.1	3839.6	2.18
			40 33 00	Barnwell	220 32 27	2479.1	2711.1	1.54
Lady	32 29 47.76	80 36 10.73	228 31 46	Bull	48 32 45	3797.9	4153.2	2.36
			293 04 06	Parrott	113 06 09	6482.1	7088.6	4.03
Chisolm	32 31 43.65	80 38 15.12	279 48 24	Bull	99 50 29	6182.2	6760.6	3.84
			317 42 22	Lady	137 43 29	4825.0	5275.5	3.00
Brick-yard	32 30 07.20	80 40 16.20	275 19 20	Lady	95 21 32	6435.1	7037.3	4.00
			258 16 32	Bull	78 19 43	9448.6	10332.7	5.87
Boat House	32 31 30.96	80 40 27.04	295 23 50	Lady	115 26 08	7405.9	8098.8	4.60
			353 44 28	Brick-yard	173 44 34	2595.1	2837.9	1.61
Rose Bank, lightning rod	32 32 30.95	80 43 00.40	294 46 39	Boat House	114 48 02	4407.7	4820.1	2.74
			315 55 37	Brick-yard	135 57 05	6161.3	6737.8	2.83
Samphire	32 31 54.31	80 43 32.96	216 57 56	Rose Bank, lightning rod	36 58 14	1412.8	1545.0	0.88
			295 28 29	Bee	115 29 02	1789.9	1957.4	1.11
N. Ferry Landing, post	32 32 27.74	80 44 29.19	267 32 57	Rose Bank, lightning rod	87 33 45	2318.8	2535.7	1.44
			305 03 42	Samphire	125 04 12	1792.6	1960.3	1.11
Ferry House, chimney	32 32 21.76	80 44 30.20	283 50 14	Boat House	103 52 25	6534.8	7146.2	4.06
			299 31 06	Samphire	119 31 37	1716.1	1876.7	1.07
Brick Kiln, south apex	32 30 48.57	80 41 37.23	234 31 02	Boat House	54 31 40	2249.3	2459.8	1.40
			145 28 17	Rose Bank, lightning rod	325 27 32	3828.1	4186.3	2.38
Penyclear's Pine	32 30 09.76	80 41 33.53	272 13 21	Brick-yard	92 14 03	2020.0	2209.0	1.26
			274 34 22	Lady	94 37 15	8452.8	9243.8	5.25
Bee	32 31 29.31	80 42 31.04	328 30 23	Penyclear's Pine	148 30 54	2873.6	3142.4	1.79
			305 41 28	Brick-yard	125 42 40	4333.7	4739.2	2.69
Pigeon Point Pine	32 27 03.22	80 40 00.82	290 40 39	Johnson	110 41 02	1176.0	1286.1	0.73
			7 43 08	Church	187 43 03	1822.6	1993.1	1.13
Albergottie	32.26 44.78	80 41 10.93	252 45 40	Pigeon Point Pine	72 46 18	1917.0	2096.3	1.19
			307 57 57	Church	127 58 30	2012.3	2200.6	1.25
Cuthbert	32 27 53.85	80 40 22.99	30 29 51	Albergottie	210 29 25	2467.9	2698.8	1.53
			319 37 55	Johnson	139 38 30	2592.9	2835.5	1.61
Travis	32 28 00.25	80 41 23.59	277 06 50	Cuthbert	97 07 23	1594.9	1744.2	0.99
			351 54 20	Albergottie	171 54 27	2347.6	2567.2	1.46
Hamilton	32 29 09.88	80 40 49.23	343 41 32	Cuthbert	163 41 46	2440.3	2668.6	1.52
			22 42 26	Travis	202 42 08	2324.5	2542.0	1.45
Gevins	32 28 38.85	80 41 49.05	330 47 21	Travis	150 47 35	1362.0	1489.4	0.85
			238 31 57	Hamilton	58 32 29	1830.9	2002.2	1.14
Talbot's House	32 28 22.06	80 41 39.51	154 17 13	Gevins	334 17 08	574.0	627.7	0.36
			221 42 24	Hamilton	41 42 51	1973.0	2157.6	1.23
Bush on Shoal	32 28 10.35	80 41 15.17	35 16 00	Travis	215 15 55	381.0	416.7	0.24
			134 46 32	Gevins	314 46 14	1246,2	1362.8	0.77
Leaning Beacon	32 30 47.45	80 40 08.55	286 28 59	Lady	106 31 07	6473.8	7079.6	4.02
			9 09 08	Brick-yard	189 09 04	1255.5	1373.0	0.78

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Section V.—St. Helena Sound to Port Royal Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Dr. Johnson's House	32 29 50.59	80 39 43.47	213 30 10	Chisolm	33 30 57	4176.7	4567.5	2.60
			253 51 13	Bull	73 54 06	8742.5	9560.5	5.43
J. F. Chaplin's House	32 30 03.67	80 40 25.86	274 11 17	Lady	94 13 34	6678.7	7303.6	4.15
			227 54 37	Chisolm	47 55 47	4595.3	5025.3	2.85
Dr. Croft's House, centre	32 26 02.75	80 33 07.38	195 00 20	Parrott	15 00 44	4544.0	4969.2	2.82
			180 06 54	Squat	0 06 54	7702.7	8423.5	4.79
Mrs. Sams' House	32 29 19.18	80 35 47.10	213 17 10	Bull	33 17 56	4061.5	4441.5	2.52
			275 06 10	Barnwell	95 07 03	2584.6	2826.4	1.61
Southernmost of three Pines	32 29 21.68	80 36 39.63	254 09 08	Squat	74 11 02	5774.3	6314.6	3.59
			252 54 50	Hangman 2	72 57 47	8969.4	9808.7	5 57
Turnip Top Pine	32 31 36.87	80 34 25.36	321 36 20	Squat	141 37 02	3302.8	3611.9	2.06
			353 32 39	Bull	173 32 41	851.5	931.1	0.53
Chimney without house	32 33 35.21	80 31 31.66	44 39 42	Bull	224 38 10	6312.9	6903.6	3.92
			21 42 48	Squat	201 41 57	6708.9	7336.6	4.17
Petrel	32 29 59.51	80 31 49.15	16 36 19	Parrott	196 36 01	3030.5	3314.0	1.88
			214 03 47	Hangman 2	34 04 07	1771.5	1937.2	1.10
Double Pine, centre between the two trees.	32 31 12.36	80 34 23.97	46 55 25	Lady	226 54 28	3815.7	4172.7	2.37
			278 45 22	Hangman 2	98 47 06	5092.3	5568.8	3.16
Opposite Signal	32 29 56.01	80 35 01.02	204 25 07	Bull	24 25 28	2482.9	2715.3	1.54
			314 54 18	Barnwell	134 54 46	1934.7	2115.7	1.20
Creek	32 30 40.93	80 38 36.33	195 58 21	Chisolm	15 58 32	2009.6	2197.6	1.25
			68 15 54	Brick-yard	248 15 00	2806.3	3068.9	1.74
Brooklyn	32 20 53.18	80 40 23.63	182 05 41	Church	2 05 48	9597.2	10495.2	5.96
			331 20 33	Port Royal	151 21 38	6583.9	7200.0	4.09
Capers	32 22 09.22	80 37 45.29	152 25 52	Church	332 24 34	8178.1	8943.4	5.08
			60 30 37	Brooklyn	240 29 12	4755.8	5200.8	2.95
Orange Grove	32 24 06.96	80 39 49.06	171 20 04	Church	351 19 53	3663.9	4006.8	2.28
			318 15 39	Capers	138 16 45	4859.6	5314.3	3.02
Road	32 25 13.95	80 41 02.59	221 16 53	Church	41 17 21	2074.3	2268.4	1.29
			317 02 24	Orange Grove	137 03 03	2819.2	3083.0	1.75
White Hall	32 25 15.16	80 39 49.47	160 24 44	Church	340 24 33	1614.8	1765.9	1.00
			88 53 02	Road	268 52 23	1910.6	2089.4	1.19
Sams	32 25 59.49	80 38 37.86	93 41 59	Church	273 41 10	2416.9	2643.0	1.50
			53 52 29	White Hall	233 51 51	2316.1	2532.8	1.44
Johnson	32 26 49.70	80 39 18.70	44 02 47	Church	224 02 19	1934.8	2115.8	1.20
			325 24 02	Sams	145 24 24	1878.6	2054.4	1.17
Chaplin	32 19 40.60	80 38 28.33	126 35 28	Brooklyn	306 34 26	3751.1	4102.1	2.33
			193 50 07	Capers	13 50 30	4714.3	5155.4	2.93
Joyner	32 23 05.44	80 40 28.61	292 03 26	Capers	112 04 54	4608.8	5040.0	2.86
			358 07 44	Brooklyn	178 07 47	4075.7	4457.1	2.53
Parry	32 18 06.52	80 40 52.56	188 24 52	Brooklyn	8 25 08	5189.0	5674.5	3.22
			232 27 44	Chaplin	52 29 01	4756.8	5201.9	2.96
Webb	32 17 45.74	80 38 26.99	99 33 10	Parry	279 31 52	3861.6	4223.0	2.40
Point	32 24 34.07	80 24 46.22	136 11 07	Morgan	316 09 08	8363.5	9146.0	5.20
			182 13 43	Otter Island	2 13 49	7235.1	7912.1	4.50
Butcher's Island	32 24 29.23	80 27 48.73	268 11 38	Point	88 13 16	4771.1	5217.5	2.97
			271 00 46	Coffin	91 02 23	4737.0	5180.2	2.94
Egg Bank, 1856	32 26 17.61	80 26 07.18	210 39 22	Otter Island	30 40 12	4697.3	5136.8	2.92
			326 26 33	Point	146 27 16	3826.6	4184.6	2.38
Bog Island	32 21 51.98	80 27 51.89	224 10 18	Point	44 11 58	6962.2	7613.6	4.33
			225 21 18	Coffin	45 22 57	6773.1	7406.9	4.21
Cherry Hill Knoll	32 22 45.05	80 30 40.93	234 29 40	Butcher's Island	54 31 12	5526.8	6043.9	3.43
			290 17 16	Bog Island	110 18 47	4710.9	5151.7	2.93
Story	32 19 24.96	80 31 34.41	192 46 49	Cherry Hill Knoll	12 47 18	6319.3	6910.6	3.93
			232 05 22	Bog Island	52 07 21	7372.6	8062.4	4.58
Pritchard	32 20 20.24	80 34 53.06	235 53 49	Cherry Hill Knoll	55 56 04	7958.6	8703.3	4.94
			288 07 55	Story	108 09 41	5466.7	5978.2	3.40
Trenchard	32 16 02.14	80 34 31.94	176 01 35	Pritchard	356 01 24	7968.8	8714.4	4.95
			216 38 57	Story	36 38 32	7784.3	8512.7	4.84

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	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Shell	32 18 21.19	80 33 19.77	234 30 32	Story	54 31 29	3384.1	3700.8	2.10
			23 47 57	Trenchard	203 47 18	4680.5	5118.4	2.91
Station Island	32 16 54.70	80 38 15.60	219 54 28	Pritchard	39 56 16	8255.0	9027.5	5.13
			285 26 42	Trenchard	105 28 41	6072.1	6640.3	3.77
Cross	32 14 08.63	80 40 25.44	213 35 18	Station Island	33 36 27	6140.6	6715.2	3.82
			249 16 27	Trenchard	69 19 36	9890.6	10816.1	6.15
Parry	32 18 06.52	80 40 52.56	298 18 04	Station Island	118 19 28	4664.4	5100.8	2.90
			354 27 51	Cross	174 28 06	7361.3	8050.1	4.57
Daw	32 18 12.17	80 44 14.91	271 51 55	Parry	91 53 43	5295.9	5791.4	3.29
			284 12 58	Station Island	104 16 10	9698.2	10605.7	6.03
Skull	32 15 36.77	80 44 12.08	179 06 52	Daw	359 06 51	4786.8	5234.7	2.97
			228 31 22	Parry	48 33 09	6966.1	7617.9	4.33
Oyster	32 17 31.35	80 45 40.39	261 47 23	Parry	81 49 57	7607.0	8318.7	4.73
			240 38 41	Daw	60 39 26	2565.3	2805.3	1.59
Dick	32 15 27.19	80 46 12.36	211 09 23	Daw	31 10 26	5938.2	6493.9	3.69
			192 20 22	Oyster	12 20 39	3914.3	4280.6	2.43
Graham	32 13 20.50	80 45 17.25	159 42 57	Dick	339 42 27	4160.1	4549.3	2.59
			202 06 54	Skull	22 07 29	4530.4	4954.3	2.82
Jessie 2	32 13 00.49	80 48 24.56	217 26 21	Dick	37 27 32	5691.3	6223.8	3.54
			262 49 24	Graham	82 51 04	4942.7	5405.2	3.07
Spanish Wells	32 11 29.33	80 46 43.62	136 44 13	Jessie 2	316 43 19	3856.4	4217.2	2.40
			213 26 11	Graham	33 26 57	4103.6	4487.5	2.55
Barataria	32 11 14.60	80 48 22.07	178 51 16	Jessie 2	358 51 15	3262.1	3567.3	2.03
			260 01 07	Spanish Wells	80 01 59	2618.1	2863.1	1.63
Ficklin	32 13 50.20	80 47 48.86	338 30 14	Spanish Wells	158 30 49	4662.9	5099.2	2.90
			282 57 52	Graham	102 59 13	4073.0	4454.1	2.53
Cedar	32 20 40.56	80 28 33.05	138 55 40	Cherry Hill Knoll	318 54 31	5086.9	5562.8	3.16
			206 03 38	Bog Island	26 04 00	2449.0	2678.1	1.52
Tom 2	32 20 41.36	80 27 50.51	88 43 53	Cedar	268 43 30	1112.6	1216.7	0.69
			179 02 48	Bog Island	359 02 47	2175.6	2379.1	1.35
Philipp 2	32 20 13.87	80 27 44.28	122 48 47	Cedar	302 48 21	1517.1	1659.1	0.94
			169 07 20	Tom 2	349 07 17	862.3	943.0	0.54
Seib 2	32 20 05.81	80 26 48.99	99 44 13	Philipp 2	279 43 43	1467.0	1604.2	0.91
			124 14 37	Tom 2	304 14 04	1945.8	2127.8	1.21
Sand	32 20 34.71	80 26 36.31	20 25 41	Seib 2	200 25 34	949.8	1038.7	0.59
			70 08 36	Philipp 2	250 08 00	1885.4	2061.8	1.17
Spit 2	32 19 34.04	80 26 27.92	150 37 00	Seib 2	330 36 49	1123.1	1228.2	0.70
			173 18 00	Sand	353 17 56	1881.5	2057.5	1.17
Fripp	32 19 34.35	80 27 10.47	210 05 27	Seib 2	30 05 39	1120.2	1225.0	0.70
			270 28 48	Spit 2	90 29 11	1112.8	1217.0	0.69
Palmetto, (Fripp's Inlet)	32 19 50.57	80 27 09.32	145 27 27	Tom 2	325 27 05	1899.2	2076.9	1.18
			228 33 04	Seib 2	48 33 15	709.4	775.8	0.44
Jones	32 22 24.71	80 25 42.78	12 39 24	Spit 2	192 39 00	5387.3	5891.4	3.35
			22 02 04	Seib 2	202 01 29	4614.8	5046.6	2.87
West Base	32 30 28.67	80 19 21.10	37 52 47	Point	217 49 53	13834.7	15129.2	8.60
			53 55 13	Egg Bank	233 51 35	13123.5	14351.5	8.16
Shoal	32 28 06.37	80 23 02.46	22 31 08	Point	202 30 12	7078.7	7741.0	4.40
			105 53 34	Otter Island	285 52 44	2524.1	2760.3	1.57
Bay Point Signal	32 29 18.37	80 20 14.62	39 01 45	Point	218 59 19	11269.1	12323.5	7.00
			58 51 44	Egg Bank	238 48 35	10758.7	11765.3	6.69
David	32 29 05.03	80 19 17.13	45 52 03	Point	225 49 06	11980.1	13101.0	7.45
			64 18 57	Egg Bank	244 15 17	11884.5	12996.5	7.38
House on Hunting Island	32 23 29.97	80 25 44.41	173 25 47	Egg Bank	353 25 35	5197.6	5683.9	3.23
			217 35 51	Point	37 36 22	2492.0	2725.2	1.55
Butcher's Island Pine	32 24 30.70	80 27 48.82	268 44 20	Point	88 45 58	4772.1	5218.6	2.97
			357 02 59	Butcher's Island	177 02 59	45.5	49.7	0.03
Charity	32 24 50.76	80 27 35.05	276 37 55	Point	96 39 25	4441.2	4856.8	2.76
			165 56 35	Morgan	345 56 07	5689.2	6221.6	3.53
Anderson	32 26 26.28	80 28 14.46	172 12 11	Morgan	352 12 04	2601.5	2844.9	1.62
			302 24 46	Point	122 26 38	6445.2	7048.3	4.00

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Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Outer Channel Stake	32 24 59.50	80 26 03.80	291 07 16	Point	111 07 58	2172.9	2376.2	1.35
			71 13 29	Butcher's Island	251 12 33	2895.9	3166.8	1.80
Inner Channel Stake	32 24 47.11	80 26 01.32	281 34 03	Point	101 34 43	2002.7	2190.1	1.25
			78 54 01	Butcher's Island	258 53 03	2860.1	3127.7	1.78
House on Hunting Island, west chimney.	32 22 48.25	80 26 26.00	89 10 16	Cherry Hill Knoll	269 08 00	6663.2	7286.7	4.14
			145 12 33	Butcher's Island	325 11 49	3787.7	4142.1	2.35
Mud Signal	32 20 38.68	80 30 40.71	179 55 00	Cherry Hill Knoll	359 55 00	3892.2	4256.4	2.42
			212 19 17	Butcher's Island	32 20 49	8404.3	9190.7	5.22
Rain Signal	32 19 13.01	80 30 32.42	102 48 09	Story	282 47 36	1662.5	1818.0	1.03
			220 35 30	Bog Island	40 36 56	6449.4	7052.9	4.01
Edgar Fripp's House, west chimney	32 21 02.30	80 34 00.35	238 43 24	Cherry Hill Knoll	58 45 11	6098.3	6668.9	3.78
			260 56 43	Bog Island	81 00 00	9753.0	10665.6	6.06
Cherry Hill House, west chimney	32 23 16.25	80 30 49.26	299 13 54	Bog Island	119 15 29	5313.0	5810.2	3.30
			323 23 55	Cedar	143 25 08	5972.8	6531.7	3.71
Dr. Jenkins' House, west chimney	32 19 23.71	80 36 06.97	233 56 06	Cherry Hill Knoll	53 59 00	10540.2	11526.4	6.55
			293 44 48	Shell	113 46 17	4779.7	5226.9	2.97
Small White Building	32 22 29.76	80 31 30.10	249 52 42	Cherry Hill Knoll	69 53 08	1368.9	1496.9	0.85
			305 59 35	Cedar	126 01 10	5721.5	6256.8	3.56
Capers	32 19 20.25	80 33 32.21	267 17 33	Story	87 18 36	3084.1	3372.7	1.92
			131 09 28	Pritchard	311 08 45	2808.0	3070.7	1.74
Luce	32 16 45.33	80 35 02.23	222 13 49	Shell	42 14 44	3987.7	4360.8	2.48
			329 12 46	Trenchard	149 13 02	1548.5	1693.4	0.96
Monk	32 16 04.48	80 34 49.22	209 03 35	Shell	29 04 23	4817.1	5267.9	2.99
			279 04 58	Trenchard	99 04 59	457.8	500.6	0.28
Chaplin's House, west chimney	32 18 30.46	80 37 07.82	226 10 13	Pritchard	46 11 25	4883.5	5340.4	3.04
			32 40 53	Cross	212 39 08	9579.2	10475.6	5.95
Pritchard's Pine, flag	32 17 01.58	80 32 16.01	83 26 58	Luce	263 25 29	4377.6	4787.2	2.72
			145 46 54	Shell	325 46 20	2965.4	3242.9	1.84
Cole	32 15 33.12	80 37 15.47	258 11 11	Trenchard	78 12 38	4371.8	4780.9	2.72
			62 23 14	Cross	242 21 33	5611.9	6137.0	3.49
Webb's Summer house, apex	32 17 23.60	80 38 29.90	337 12 08	Station Island	157 12 16	965.6	1055.9	0.60
			26 44 05	Cross	206 43 03	6723.3	7352.4	4.18
Pest	32 15 26.24	80 38 05.68	56 50 58	Cross	236 49 43	4369.7	4778.6	2.71
			174 33 24	Station Island	354 33 19	2736.6	2992.6	1.70
Whitey	32 14 12.92	80 40 24.18	140 41 10	Daw	320 39 07	9526.4	10417.8	5.92
			214 01 24	Station Island	34 02 33	6012.4	6575.0	3.74
Cosine	32 14 29.47	80 40 46.11	178 33 08	Parry	358 33 05	6687.1	7312.9	4.15
			221 21 19	Station Island	41 22 39	5960.3	6518.0	3.70
Dolphin, flag	32 16 02.85	80 42 50.30	257 27 21	Station Island	77 29 48	7363.4	8052.4	4.58
			218 56 55	Parry	38 57 58	4898.6	5357.0	3.04
Dolphin, tripod	32 16 02.91	80 42 50.15	218 55 51	Parry	38 56 54	4895.0	5353.1	3.04
			257 27 41	Station Island	77 30 08	7359.0	8047.5	4.57
Pinckney House, chimney	32 16 38.28	80 45 05.11	204 25 30	Daw	24 25 57	3175.7	3472.8	1.97
			247 37 08	Parry	67 39 23	7144.4	7812.9	4.44
Elliott's Cotton House, flag	32 18 27.35	80 45 09.65	344 00 02	Skull	164 00 33	5465.7	5977.1	3.40
			288 04 58	Daw	108 05 27	1506.3	1647.2	0.94
Palmetto on Daw's Island	32 19 15.60	80 44 50.65	288 50 36	Parry	108 52 43	6580.7	7196.5	4.09
			334 25 30	Daw	154 25 49	2165.8	2368.4	1.35
Buoy on Parry Island Shoal	32 16 36.56	80 39 48.47	148 52 17	Parry	328 51 43	3242.5	3545.9	2.02
			257 00 37	Station Island	77 01 27	2493.5	2726.8	1.55
Drayton's House, centre	32 14 38.26	80 41 15.03	144 28 15	Daw	324 26 39	8097.1	8854.8	5.03
			185 14 01	Parry	5 14 13	6441.5	7044.2	4.00
Elliott	32 15 51.75	80 42 26.30	121 08 56	Oyster	301 07 12	5932.8	6488.0	3.69
			210 34 08	Parry	30 34 58	4821.5	5272.6	3.00
Pine on Pinckney Island	32 15 23.76	80 45 17.91	171 29 27	Oyster	351 29 15	3973.2	4345.0	2.47
			256 54 27	Skull	76 55 02	1768.8	1934.3	1.10
Seabrook's House, west chimney	32 15 35.92	80 44 11.10	178 48 44	Daw	358 48 42	4813.7	5264.1	2.99
			135 11 25	Skull	315 11 25	36.5	39.9	0.02
Pope	32 15 32.85	80 44 14.85	86 46 04	Dick	266 45 01	3080.4	3368.6	1.91
			179 58 56	Daw	359 58 56	4906.9	5366.0	3.05

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Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Oyster 2	32 17 31.34	80 45 40.37	240 38 17	Daw	60 39 03	2565.0	2805.0	1.59
			326 46 56	Skull	146 47 43	4217.7	4612.3	2.62
Banana	32 19 57.05	80 46 31.09	343 31 47	Oyster 2	163 32 14	4679.8	5117.7	2.91
			312 11 55	Daw	132 13 08	4808.4	5258.3	2.99
Edwards	32 19 19.70	80 47 57.78	243 05 12	Banana	63 05 58	2542.3	2780.2	1.58
			289 37 13	Daw	109 39 12	6189.2	6768.4	3.85
Hilton	32 12 55.02	80 40 01.26	221 41 59	Cole	41 43 28	6522.3	7132.6	4.05
			200 31 49	Station Island	20 32 45	7883.5	8621.1	4.90
Shoal	32 11 52.83	80 38 49.10	135 23 55	Hilton	315 23 17	2690.9	2942.7	1.67
			199 51 22	Cole	19 52 12	7213.9	7888.9	4.48
Creek	32 11 36.84	80 41 20.88	262 55 48	Shoal	82 57 09	4005.4	4380.2	2.49
			220 53 00	Hilton	40 53 42	3185.2	3483.3	1.98
Black Pine	32 10 00.93	80 42 30.84	239 18 03	Shoal	59 20 01	6753.7	7385.6	4.20
			216 08 29	Hilton	36 09 49	6640.8	7262.2	4.13
Hunter	32 20 58.60	80 39 13.74	333 41 51	Chaplin	153 42 15	2679.6	2930.3	1.66
			84 46 47	Brooklyn	264 46 10	1832.2	2003.6	1.14
Old Fort	32 24 31.91	80 40 27.63	307 15 19	Orange Grove	127 15 40	1269.3	1388.1	0.79
			216 52 40	White Hall	36 53 01	1665.4	1821.2	1.04
Black Buoy on East end of Shoal	32 13 13.36	80 37 54.51	29 57 24	Shoal	209 56 55	2862.8	3130.7	1.75
			80 21 12	Hilton	260 20 04	3366.4	3681.4	2.09
Perpendicular striped Buoy	32 11 20.87	80 35 47.18	101 41 02	Shoal	281 39 25	4865.0	5320.2	3.02
			113 34 05	Hilton	293 31 49	7258.1	7937.3	4.51
Light Ship 1859, (approximate)	32 05 08.6	80 34 53.9	153 41 00	Shoal	333 38 55	13893.0	15193.0	8.63
			150 45 03	Hilton	330 42 19	16470.0	18011.1	10.23
Cat Island Pine	32 21 31.23	80 39 01.02	18 18 43	Hunter	198 18 36	1058.7	1157.8	0.66
			61 29 47	Brooklyn	241 29 03	2454.7	2684.4	1.53
Edding's Magnolia	32 20 06.62	80 42 35.00	45 24 21	Oyster 2	225 22 42	6811.2	7448.5	4.23
			87 17 24	Banana	267 15 18	6180.0	6758.3	3.84
Mrs. Reed's House, centre chimney	32 22 18.02	80 40 07.13	188 02 39	Orange Grove	8 02 49	3387.3	3704.3	2.10
			9 18 35	Brooklyn	189 18 26	2646.7	2894.3	1.65
Cuthbert Castle, apex	32 26 00.26	80 40 31.55	256 43 32	Church	76 43 44	575.9	629.7	0.36
			29 32 12	Road	209 31 55	1639.4	1792.8	1.02
Beaufort Episcopal Church, bell	32 26 02.28	80 40 16.23	334 12 07	White Hall	154 12 21	1612.0	1762.9	1.00
			39 04 12	Road	219 03 47	1917.4	2096.8	1.19
E. A. Fripp's House, cupola	32 26 06.85	80 39 37.55	278 14 58	Sams'	98 15 30	1578.8	1726.5	0.98
			24 06 46	Old Fort	204 06 19	3204.0	3503.8	1.99
Isaac Fripp's House, chimney with rod.	32 20 37.12	80 38 18.56	114 38 16	Hunter	294 37 46	1587.0	1735.4	0.99
			1 12 52	Port Royal	181 12 50	5283.1	5777.4	3.28
Orange Grove Pine	32 24 23.55	80 39 27.96	47 03 15	Orange Grove	227 03 04	749.7	819.8	0.46
			33 22 42	Joyner	213 22 09	2881.2	3150.8	1.79
Fuller's House, west chimney	32 21 11.55	80 40 39.99	322 43 28	Brooklyn	142 43 37	710.4	776.8	0.44
			309 07 36	Chaplin	129 08 46	4438.6	4853.9	2.76
Beacon on Flats	32 25 35.02	80 40 06.32	324 06 09	White Hall	144 06 18	755.3	825.9	0.47
			173 47 51	Church	353 47 49	914.9	1000.5	0.57
Ferry House, west end of roof	32 25 11.89	80 39 31.19	223 34 46	Sams'	43 35 15	2024.3	2213.7	1.26
			91 31 53	Road	271 31 04	2386.0	2609.3	1.48
Sams' House, chimney with lightning rod.	32 26 02.96	80 38 35.70	91 08 50	Church	271 07 59	2466.1	2696.9	1.53
			26 47 21	Sams'	206 47 20	119.4	130.6	0.07
Sams' House, centre chimney	32 26 02.96	80 38 35.32	46 18 01	Old Fort	226 17 01	4058.7	4438.5	2.52
			68 34 16	Road	248 32 57	4130.1	4516.5	2.57
Whitewashed chimney, Old Fort, (hydr.)	32 24 34.66	80 40 32.68	147 14 15	Road	327 13 59	1438.8	1573.4	0.89
			192 01 45	Church	12 01 57	2830.7	3095.6	1.76
Gibbs's House, southeast chimney	32 23 22.57	80 39 36.34	68 52 47	Joyner	248 52 19	1464.4	1601.4	0.91
			166 24 26	Orange Grove	346 24 19	1406.2	1537.8	0.87
Board Pine, (hydr.)	32 24 46.91	80 40 49.32	240 56 58	White Hall	60 57 30	1791.5	1959.1	1.11
			203 11 43	Church	23 12 04	2601.7	2845.2	1.62
Pinckney Island, Overseer's House	32 15 15.63	80 48 04.55	253 04 24	Port Royal	73 09 35	15906.6	17395.0	9.88
			241 31 38	Chaplin	61 36 46	17142.2	18746.2	10.65
Saxby Chaplin's House, west chimney.	32 27 37.27	80 39 23.07	23 16 24	Church	203 15 59	3108.9	3399.8	1.93
			355 26 46	Johnson	175 26 48	1469.9	1607.4	0.91

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section V.—St. Helena Sound to Port Royal Sound.

Name of station.	Latitude. ° ′ ″	Longitude. ° ′ ″	Azimuth. ° ′ ″	To station.	Back Azimuth. ° ′ ″	Distance. Metres.	Distance. Yards.	Dist. Miles.
Middle Cotton house at Oaks	32 23 21.70	80 36 56.99	28 25 05	Capers	208 24 40	2538.1	2775.6	1.58
			38 38 18	Hunter	218 37 06	5642.1	6170.0	3.51
Red Bluff	32 21 03.21	80 47 08.66	21 56 48	Edwards	201 56 22	3437.2	3758.8	2.14
			319 12 33	Daw	139 14 06	6956.8	7607.7	4.32
White House, northwest chimney	32 23 09.65	80 45 06.30	32 21 34	Edwards	212 19 32	8381.5	9165.7	5.21
			351 39 17	Daw	171 39 44	9261.7	10128.3	5.75
Baker	32 18 59.51	80 38 27.39	66 45 16	Parry	246 43 58	4132.9	4519.6	2.57
			359 44 23	Webb	179 44 23	2272.0	2484.6	1.41
Cask	32 18 03.18	80 39 41.28	285 26 14	Webb	105 26 54	2016.1	2204.8	1.25
			228 04 53	Baker	48 05 33	2597.2	2840.2	1.61
Bouncer	32 19 28.35	80 39 37.80	1 59 19	Cask	181 59 08	2625.1	2870.8	1.63
			295 45 00	Baker	115 45 38	2044.4	2235.7	1.27
Caswell	32 20 04.18	80 38 39.89	53 55 25	Bouncer	233 54 54	1873.7	2049.0	1.16
			350 41 13	Baker	170 41 20	2018.5	2207.4	1.25
Oar	32 19 47.22	80 38 37.47	195 44 54	Hunter	15 45 07	2283.7	2497.3	1.42
			250 51 57	Caswell	70 52 28	1593.7	1742.8	0.99
Petrel	32 20 56.26	80 39 53.71	348 42 20	Oar	168 42 29	2168.3	2371.2	1.35
			266 04 16	Hunter	86 04 37	1046.9	1144.8	0.65
Creek	32 20 20.97	80 39 46.12	169 39 50	Petrel	349 39 46	1104.9	1208.3	0.69
			352 21 17	Bouncer	172 21 21	1635.2	1788.2	1.02
Reed's Oak, flag	32 22 11.46	80 40 10.81	349 02 52	Petrel	169 03 01	2339.6	2560.4	1.47
			7 52 33	Brooklyn	187 52 26	2433.5	2661.2	1.51
Chisolm's House, chimney in centre.	32 20 53.50	80 38 15.92	22 23 39	Caswell	202 23 26	1645.8	1799.8	1.02
			46 12 43	Oar	226 11 59	2953.8	3230.2	1.84
Boat House, west apex	32 20 39.26	80 38 36.40	4 50 06	Caswell	184 50 04	1084.3	1185.8	0.67
			44 53 42	Oar	224 53 09	2262.6	2474.3	1.41
Northernmost of three Pines	32 20 41.27	80 41 17.79	320 25 32	Webb	140 27 03	7013.6	7669.8	4.36
			302 22 30	Oar	122 23 24	3106.2	3396.9	1.93
Dr. Mean's Boat House, east apex	32 18 21.11	80 40 17.84	289 57 44	Port Royal	109 58 46	3200.1	3499.5	1.99
			310 00 03	Cask	130 00 23	1104.5	1207.8	0.69
Pine with board nailed on	32 18 51.43	80 38 25.15	166 42 54	Baker	346 42 53	255.6	279.5	0.16
			1 21 50	Webb	181 21 49	2023.5	2212.8	1.26
Spence, flag in tree	32 18 09.62	80 38 22.51	9 03 26	Webb	189 03 24	744.7	814.3	0.46
			140 55 20	Bouncer	320 54 40	3124.1	3416.4	1.94
Sapelo to St. Simon's Sound, including Altamaha Sound.								
NORTH BASE	31 31 43.21	81 13 57.98						
CEDAR HAMMOCK	31 33 17.96	81 14 43.28	337 43 46	North Base	157 44 10	3153.1	3448.1	1.96
North side of Sound	31 33 36.44	81 12 34.83	32 10 11	North Base	212 09 28	4119.4	4504.9	2.56
			80 28 11	Cedar Hammock	260 27 04	3434.7	3756.0	2.13
Pea	31 31 34.31	81 13 34.98	150 34 05	Cedar Hammock	330 33 29	3665.1	4008.1	2.28
			202 51 58	North side of Sound	22 52 29	4082.0	4464.0	2.54
Bayonet	31 31 05.06	81 12 35.96	120 03 22	Pea	300 02 51	1796.8	1967.1	1.12
			180 21 59	North side of Sound	0 22 00	4662.1	5098.3	2.90
Oyster	31 29 40.01	81 13 18.62	173 00 20	Pea	353 00 20	3546.7	3878.5	2.20
			203 14 53	Bayonet	23 15 15	2851.0	3117.8	1.77
Fisherman	31 29 34.50	81 12 30.39	97 35 17	Oyster	277 34 52	1283.8	1404.0	0.80
			176 59 03	Bayonet	356 59 00	2792.8	3054.2	1.74
Moss	31 28 45.77	81 12 41.13	149 21 44	Oyster	329 21 24	1941.3	2122.9	1.21
			190 41 14	Fisherman	10 41 20	1527.3	1670.2	0.95
Palm	31 28 53.82	81 13 12.83	173 32 15	Oyster	353 32 15	1430.4	1564.2	0.89
			286 30 31	Moss	106 30 48	872.7	954.4	0.54
Scrub	31 28 09.00	81 13 05.74	172 16 55	Palm	352 16 51	1393.0	1523.4	0.87
			209 50 41	Moss	29 50 54	1305.5	1427.6	0.81
Otter	31 28 04.17	81 13 25.08	222 09 37	Moss	42 10 00	1728.2	1889.9	1.07
			253 45 16	Scrub	73 45 26	531.6	581.4	0.33
Sand Hill	31 27 23.94	81 13 10.18	162 23 32	Otter	342 23 24	1300.0	1421.6	0.81
			184 49 31	Scrub	4 49 33	1392.7	1523.1	0.87
Sedge	31 27 25.77	81 13 43.99	217 10 16	Scrub	37 10 36	1670.7	1827.1	1.04
			273 37 24	Sand Hill	93 37 42	894.2	977.9	0.56

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Sapelo to St. Simon's Sound, including Altamaha Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Caberita	31 26 38.63	81 13 37.77	173 33 25	Sedge	353 33 22	1461.0	1597.7	0.91
			207 34 06	Sand Hill	27 34 20	1574.0	1721.3	0.98
Chaparral	31 26 26.82	81 14 20.39	207 53 25	Sedge	27 53 44	2054.3	2246.5	1.28
			252 04 41	Caberita	72 05 03	1182.4	1293.0	0.73
Lowe	31 25 49.92	81 14 17.43	176 03 57	Chaparral	356 03 55	1136.9	1245.4	0.71
			214 54 42	Caberita	34 55 03	1829.1	2000.3	1.14
White flag on Black Beard Beach	31 27 58.85	81 12 50.44	169 57 29	Pea	349 57 06	6738.8	7369.3	4.19
			166 34 35	Oyster	346 34 20	3202.7	3502.4	1.99
White flag in Pine	31 29 49.10	81 13 16.17	204 23 26	Bayonet	24 23 47	2568.6	2808.9	1.60
			290 24 33	Fisherman	110 24 57	1288.9	1409.5	0.80
Gripe	31 30 27.44	81 13 25.39	228 22 26	Bayonet	48 22 52	1744.6	1907.8	1.08
			318 19 04	Fisherman	138 19 33	2182.5	2386.7	1.36
Tall Pine on Sapelo Island	31 30 45.78	81 13 39.23	184 16 52	Pea	4 16 54	1498.6	1638.8	0.93
			320 23 08	Fisherman	140 23 44	2849.3	3115.9	1.77
White flag on Shell Bank	31 31 40.50	81 12 33.13	3 55 57	Bayonet	183 55 56	1094.0	1196.4	0.68
			17 55 15	Oyster	197 54 51	3900.0	4264.9	2.42
Eagle's Nest	31 28 11.45	81 13 29.80	211 30 03	Fisherman	31 30 34	3000.1	3280.8	1.86
			230 32 51	Moss	50 33 16	1663.6	1819.2	1.03
Tall Pine near Inlet	31 26 45.64	81 14 31.81	241 18 07	Sand Hill	61 18 50	2456.8	2686.7	1.53
			278 35 50	Caberita	98 36 18	1442.9	1577.9	0.90
House, West chimney	31 26 13.48	81 14 05.07	135 26 53	Chaparral	315 26 45	576.3	630.2	0.36
			222 56 26	Caberita	42 56 40	1058.0	1157.0	0.66
Julienton	31 33 26.09	81 17 53.23	....	....	....	....	....	.....
South Base	31 30 54.35	81 14 28.00	130 49 00	Julienton	310 47 13	7151.5	7820.6	4.44
Marsh	31 28 29.04	81 16 46.23	169 04 07	Julienton	349 03 33	9317.2	10189 0	5.79
			219 10 34	South Base	39 11 46	5773.4	6313.6	3.59
Cook	31 29 49.39	81 19 32.77	256 00 30	South Base	76 03 09	8286.5	9061.9	5.15
			299 22 09	Marsh	119 23 36	5043.7	5515.6	3.13
Fox	31 25 37.67	81 21 25.35	200 57 55	Cook	20 58 54	8302.3	9079.1	5.16
			234 22 04	Marsh	54 24 30	9063.7	9911.7	5.63
Spalding	31 24 19.93	81 17 19.59	186 32 48	Marsh	6 33 06	7721.9	8444.5	4.80
			110 15 46	Fox	290 13 38	6917.7	7565.0	4.30
My Hall	31 21 54.41	81 22 59.26	199 49 58	Fox	19 50 47	7309.2	7993.2	4.54
			243 26 12	Spalding	63 29 09	10030.3	10968.8	6.23
Thalia	31 19 26.25	81 16 45.06	114 47 32	My Hall	294 44 17	10891.8	11911.0	6.77
			174 14 27	Spalding	354 14 09	9090.1	9940.6	5.65
Butler	31 17 39.67	81 20 35.39	154 08 50	My Hall	334 07 35	8717.9	9533.6	5.42
			241 39 42	Thalia	61 41 41	6918.1	7565.5	4.30
Beacon 1	31 20 14.95	81 23 08.45	230 40 27	Spalding	50 43 29	11910.8	13025.3	7.40
			184 32 57	My Hall	4 33 02	3072.2	3359.7	1.91
Beacon 2	31 19 55.36	81 23 04.78	316 35 57	Butler	136 37 15	5753.9	6292.3	3.57
			182 16 29	My Hall	2 16 32	3669.2	4012.6	2.28
Beacon 3	31 19 20.99	81 22 09.58	268 53 34	Thalia	88 56 23	8580.4	9383.2	5.33
			219 45 04	Spalding	39 47 35	11978.0	13098.8	7.44
Beacon 4	31 18 59.34	81 21 21.12	263 30 05	Thalia	83 32 29	7345.1	8032.4	4.56
			154 18 50	My Hall	334 17 59	5982.8	6542.7	3.72
Beacon 5	31 18 42.32	81 21 02.35	209 30 04	Spalding	29 32 00	11948.0	13065.9	7.42
			152 25 38	My Hall	332 24 37	6674.1	7298.6	4.15
Beacon 6	31 18 57.06	81 19 46.55	201 19 26	Spalding	21 20 42	10674.5	11673.3	6.63
			137 00 29	My Hall	316 58 49	7468.3	8167.1	4.64
Beacon 7	31 19 19.43	81 19 43.89	132 44 35	My Hall	312 43 54	7031.4	7689.3	4.37
			23 54 56	Butler	203 54 29	3360.2	3674.6	2.09
Beacon 8	31 19 57.22	81 19 16.22	283 24 50	Thalia	103 26 09	4108.0	4492.3	2.55
			26 18 14	Butler	206 17 33	4724.9	5167.1	2.94
Beacon 9	31 19 41.92	81 18 51.15	278 13 19	Thalia	98 14 25	3368.1	3683.3	2.09
			121 54 28	My Hall	301 52 19	7722.9	8445.6	4.80
Range near Beacon 9	31 19 46.09	81 18 50.44	195 52 59	Spalding	15 53 46	8768.0	9588.4	5.45
			121 01 10	My Hall	300 59 01	7672.0	8389.9	4.77

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Sapelo to St. Simon's Sound, including Altamaha Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Beacon with cross, No. 1	31 21 17.50	81 19 51.05	215 26 49	Spalding	35 28 09	6897.3	7542.7	4.29
			162 44 15	Fox	342 43 26	8390.3	9175.3	5.21
Beacon with cross, No. 2	31 20 56.62	81 19 36.01	209 54 59	Spalding	29 56 10	7224.1	7900.1	4.49
			161 33 11	Fox	341 32 14	9124.5	9978.3	5.67
Beacon 10	31 18 10.37	81 23 55.59	192 10 29	My Hall	12 10 58	7058.4	7718.9	4.39
			280 06 32	Butler	100 08 16	5377.5	5880.7	3.34
Egg Island	31 18 28.56	81 17 41.66	137 32 03	Beacon 8	317 31 14	3701.9	4048.3	2.30
			220 06 10	Thalia	40 06 39	2323.0	2540.4	1.44
Altamaha	31 17 12.90	81 16 22.91	137 51 06	Beacon 8	317 49 36	6826.8	7465.5	4.24
			138 12 50	Egg Island	318 12 09	3125.0	3417.4	1.94
Pond	31 17 17.16	81 17 28.05	195 57 20	Thalia	15 57 43	4134.7	4521.5	2.57
			170 42 10	Egg Island	350 42 03	2227.8	2436.2	1.38
Cooper	31 17 13.62	81 19 22.33	181 50 17	Beacon 8	1 50 20	5040.8	5512.5	3.13
			229 04 13	Egg Island	49 05 05	3523.0	3852.7	2.19
Pumpkin	31 27 14.85	81 17 01.54	190 01 22	Marsh	10 01 30	2320.3	2537.4	1.44
			140 01 44	Cook	320 00 25	6211.5	6792.7	3.86
Barn, peaked roof	31 25 54.76	81 16 42.55	178 49 12	Marsh	358 49 10	4752.1	5196.8	2.95
			148 08 22	Cook	328 06 53	8508.6	9304.7	5.29
Calliope	31 23 13.14	81 17 58.44	129 10 36	Fox	309 08 48	7047.9	7707.3	4.38
			73 03 24	My Hall	253 00 47	8309.6	9087.1	5.16
Citadel	31 25 57.61	81 17 28.12	84 24 58	Fox	264 22 54	6294.3	6883.2	3.91
			193 20 07	Marsh	13 20 29	4792.7	5241.2	2.98
Elysium	31 26 53.33	81 18 07.26	215 57 29	Marsh	35 58 11	3642.0	3982.8	2.26
			66 00 14	Fox	245 58 31	5725.8	6261.5	3.56
Cap	31 25 39.36	81 19 30.47	219 40 20	Marsh	39 41 45	6789.9	7425.2	4.22
			179 32 48	Cook	359 32 47	7700.4	8420.9	4.78
Aiken's Mill, chimney	31 24 17.90	81 22 16.48	14 21 20	My Hall	194 20 58	4560.8	4987.6	2.83
			228 24 08	Marsh	48 27 00	11656.0	12746.6	7.24
White Mill, cupola	31 24 19.50	81 23 00.35	269 53 28	Spalding	89 56 25	9000.3	9842.4	5.59
			359 37 52	My Hall	179 37 53	4468.4	4886.5	2.78
House with hip-roof	31 24 55.45	81 23 28.25	238 11 00	Marsh	58 14 30	12487.0	13655.4	7.76
			276 22 57	Spalding	96 26 09	9798.2	10715.0	6.09
Dido	31 26 43.47	81 20 17.14	41 37 58	Fox	221 37 22	2711.3	2965.0	1.68
			239 42 05	Marsh	59 43 55	6447.1	7050.4	4.01
Dunwoodie's House, cupola	31 25 25.75	81 22 57.48	0 24 48	My Hall	180 24 47	6508.5	7117.5	4.04
			240 01 59	Marsh	60 05 13	11310.4	12368.6	7.03
Mush	31 27 36.79	81 19 03.01	245 58 07	Marsh	65 59 18	3952.6	4322.4	2.46
			45 42 07	Fox	225 40 53	5251.7	5743.1	3.26
Cabbage	31 27 20.95	81 20 46.00	315 37 37	Spalding	135 39 25	7796.5	8526.0	4.84
			251 39 03	Marsh	71 41 08	6667.6	7291.5	4.14
Shanty	31 27 41.59	81 19 54.92	326 32 46	Spalding	146 34 07	7442.2	8138.6	4.62
			253 38 08	Marsh	73 39 47	5190.3	5675.9	3.23
Black and White Flag	31 28 31.25	81 20 24.33	327 45 58	Spalding	147 47 34	9148.5	10004.5	5.68
			209 28 46	Cook	29 29 13	2764.4	3023.0	1 72
Periwinkle	31 28 37.52	81 19 40.26	185 06 06	Cook	5 06 10	2222.3	2430.2	1.38
			273 14 23	Marsh	93 15 54	4600.5	5030.9	2.86
Sapelo Light	31 23 28.18	81 16 55.48	119 14 44	Fox	299 12 23	8167.5	8931.7	5.07
			73 18 09	My Hall	253 15 00	10035.8	10974.8	6.24
Tabby	31 25 52.28	81 18 12.39	163 48 15	Cook	343 47 33	7604.3	8315.8	4.73
			333 52 45	Spalding	153 53 13	3167.2	3463.6	1.97
Red Chimney on Doboy Island	31 23 52.63	81 19 28.58	136 22 39	Fox	316 21 38	4469.1	4887.3	2.78
			332 12 43	Thalia	152 14 08	9271.9	10139.5	5.76
Clio	31 21 53.74	81 16 30.57	163 57 26	Spalding	343 57 00	4684.6	5122.9	2.91
			4 49 22	Thalia	184 49 14	4558.1	4984.6	2.83
Bug Light	31 23 23.71	81 16 49.58	74 18 04	My Hall	254 14 52	10146.8	11096.2	6.30
			155 23 46	Spalding	335 23 30	1904.4	2082.6	1.18
Erato	31 24 03.38	81 15 28.89	13 16 40	Thalia	193 16 00	8768.3	9588.8	5.45
			22 12 25	Clio	202 11 53	4311.7	4715.2	2.68
White Chimney on Doboy Island	31 23 48.05	81 19 23.76	58 26 16	My Hall	238 24 24	6683.0	7308.4	4.15
			332 30 24	Thalia	152 31 47	9087.9	9938.2	5.65

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Sapelo to St. Simon's Sound, including Altamaha Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Wolf Island, Outer Beacon	31 21 02.87	81 16 28.24	167 24 19	Spalding	347 23 52	6218.4	6800.3	3.86
			8 30 24	Thalia	188 30 15	3008.4	3289.9	1.87
Urania	31 20 54.78	81 18 14.40	192 54 28	Spalding	12 54 57	6481.4	7087.8	4.03
			103 43 55	My Hall	283 41 27	7748.8	8473.8	4.81
Euterpe	31 22 25.12	81 19 48.80	228 05 51	Spalding	48 07 09	5295.0	5790.5	3.29
			156 44 06	Fox	336 43 16	6455.0	7059.0	4.01
Melpomene	31 18 14.02	81 17 49.85	341 46 08	Pond	161 46 19	1843.2	2015.7	1.15
			217 35 47	Thalia	37 36 21	2807.5	3070.2	1.74
Oakdale	31 24 47.98	81 17 24.00	354 04 12	Thalia	174 04 32	9960.8	10892.8	6.19
			352 19 25	Spalding	172 19 27	781.8	855.0	0.49
Cooper's House, chimney	31 17 13.71	81 19 22.35	146 27 28	My Hall	326 25 35	10373.6	11344.3	6.45
			193 52 32	Spalding	13 53 36	13520.4	14785.5	8.40
Polymnia	31 22 42.17	81 20 49.39	170 02 25	Fox	350 02 06	5487.5	6001.0	3.41
			313 02 31	Thalia	133 04 38	8837.0	9663.8	5.49
Terpsichore	31 21 53.31	81 21 30.53	235 43 09	Spalding	55 45 30	8021.0	8771.5	4.98
			90 50 01	My Hall	270 49 15	2345.0	2564.4	1.46
Wolf Island, Inner Beacon	31 21 03.36	81 16 36.76	169 25 00	Spalding	349 24 38	6157.8	6734.0	3.83
			4 12 01	Thalia	184 11 57	2999.0	3279.6	1.86
Range near Beacon 7	31 19 19.78	81 19 48.44	133 22 09	My Hall	313 20 30	6936.2	7585.2	4.31
			267 38 01	Thalia	87 39 36	4851.9	5305.9	3.01
Rokenbough's Mill, chimney	31 21 51.42	81 24 44.98	246 43 42	Spalding	68 47 34	12624.0	13805.2	7.84
			268 05 48	My Hall	88 06 43	2795.2	3056.8	1.74
Broughton Island, chimney of rice mill.	31 19 33.11	81 25 48.75	270 48 09	Thalia	90 52 52	14374.2	15719.2	8.93
			292 50 25	Butler	112 53 08	8991.3	9832.6	5.59
Butler's Rice Mill, chimney	31 21 16.07	81 26 31.84	258 06 55	My Hall	78 08 46	5740.2	6277.3	3.57
			305 14 37	Butler	125 17 42	11541.1	12620.9	7.17
Red Buoy, mouth of Darien river	31 24 34.12	81 18 36.94	282 03 49	Spalding	102 04 29	2089.0	2284.4	1.30
			325 56 11	Clio	145 57 17	5961.2	6519.0	3.70
Sea	31 15 37.68	81 16 39.94	157 26 50	Pond	337 26 25	3317.5	3627.9	2.06
			188 43 56	Altamaha	8 44 05	2966.8	3244.4	1.84
Fish	31 16 14.06	81 17 23.19	221 20 29	Altamaha	41 21 00	2413.6	2639.4	1.50
			314 23 53	Sea	134 24 15	1601.4	1751.2	1.00
Tall dead Pine	31 12 45.76	81 18 38.65	203 34 34	Altamaha	23 35 44	8976.3	9816.2	5.58
			210 40 34	Sea	30 41 36	6155.9	6731.9	3.82
Tall tree with tuft	31 14 58.88	81 17 33.34	204 17 18	Altamaha	24 17 55	4528.2	4951.9	2.81
			229 46 22	Sea	49 46 50	1850.1	2023.2	1.15
Holly	31 16 47.84	81 18 07.33	111 48 21	Cooper	291 47 42	2137.6	2337.6	1.33
			192 19 20	Egg Island	12 19 34	3174.7	3471.7	1.97
Coon	31 15 29.37	81 18 34.57	158 29 35	Cooper	338 29 10	3450.7	3773.6	2.14
			196 34 55	Holly	16 35 09	2521.4	2757.3	1.57
Fly	31 15 56.06	81 19 59.70	202 26 45	Cooper	22 27 05	2584.2	2826.0	1.61
			290 02 46	Coon	110 03 30	2397.6	2621.9	1.49
Snake	31 14 27.83	81 19 08.41	153 27 17	Fly	333 26 50	3037.5	3321.7	1.89
			205 16 31	Coon	25 16 48	2095.6	2291.7	1.30
Terrapin	31 14 16.08	81 20 31.89	233 57 39	Coon	53 58 40	3837.2	4196.3	2.38
			195 26 28	Fly	15 26 45	3194.5	3493.4	1.98
Winter	31 13 24.81	81 19 01.27	123 21 29	Terrapin	303 20 42	2871.5	3140.1	1.78
			161 37 28	Fly	341 36 58	4908.2	5367.5	3.05
Jim	31 14 26.19	81 17 49.67	45 03 54	Winter	225 03 17	2675.6	2925.9	1.66
			91 23 45	Snake	271 23 04	2084.1	2279.1	1.30
Mess	31 12 51.01	81 18 15.56	193 07 41	Jim	13 07 54	3009.5	3291.1	1.87
			130 41 39	Winter	310 41 15	1596.4	1745.8	0.99
Jack	31 12 34.32	81 19 50.99	197 50 22	Snake	17 50 44	3672.1	4015.7	2.28
			160 55 30	Terrapin	340 55 09	3315.6	3625.8	2.06
Wylly	31 12 52.32	81 21 15.77	228 52 10	Snake	48 53 16	4472.1	4890.6	2.78
			283 52 09	Jack	103 52 53	2311.7	2528.0	1.44
Single Tree	31 10 51.33	81 20 51.93	206 56 12	Jack	26 56 44	3557.8	3890.7	2.21
			170 21 51	Wylly	350 21 40	3779.4	4133.1	2.35
Thomas	31 11 37.10	81 21 34.10	237 08 17	Jack	57 09 10	3248.0	3551.9	2.02
			321 36 31	Single Tree	141 36 53	1798.4	1966.7	1.12

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Sapelo to St. Simon's Sound, including Altamaha Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Princess	31 09 26.04	81 21 43.96	207 39 34	Single Tree	27 40 01	2965.5	3243.0	1.84
			183 40 55	Thomas	3 41 01	4044.5	4422.9	2.51
Gould	31 10 11.99	81 22 14.70	241 03 18	Single Tree	61 04 01	2503.8	2738.1	1.56
			330 04 14	Princess	150 04 30	1632.7	1785.5	1.01
St. Simon's Main	31 08 17.41	81 22 31.64	210 50 03	Princess	30 50 28	2461.4	2691.7	1.53
			187 13 09	Gould	7 13 18	3556.6	3889.4	2.21
St. Simon	31 07 59.86	81 23 17.99	223 09 28	Princess	43 10 17	3638.6	3979.1	2.26
			246 13 49	St. Simon's Main	66 14 13	1341.3	1466.8	0.83
Barn, south gable	31 15 30.93	81 20 18.22	316 26 26	Snake	136 27 02	2681.0	2931.9	1.67
			8 53 40	Terrapin	188 53 33	2333.3	2551.6	1.45
Red Chimney	31 16 22.68	81 19 59.51	339 03 52	Snake	159 04 19	3786.5	4140.8	2.35
			306 08 33	Coon	126 09 17	2783.1	3043.5	1.73
William Cooper's House, east chimney.	31 14 51.94	81 20 42.83	251 13 41	Coon	71 14 47	3583.4	3918.7	2.23
			286 32 26	Snake	106 33 15	2606.4	2850.3	1.62
White Chimney	31 17 32.44	81 20 08.51	344 21 10	Snake	164 21 41	5903.6	6456.0	3.67
			326 43 40	Coon	146 44 29	4532.8	4957.0	2.82
Eagle	31 15 53.20	81 17 59.37	91 35 44	Fly	271 34 42	3184.1	3482.1	1.98
			53 27 25	Terrapin	233 26 06	5021.8	5491.7	3.12
Tall Pine	31 12 42.25	81 21 46.76	232 10 12	Snake	52 11 34	5302.7	5798.9	3.29
			274 32 35	Jack	94 33 35	3073.5	3361.1	1.91
Oscar	31 11 32.52	81 20 03.40	93 22 27	Thomas'	273 21 40	2405.0	2630.1	1.49
			195 03 23	Snake	15 03 52	5590.9	6114.0	3.47
Wylly's House, chimney	31 13 32.45	81 21 02.68	313 18 55	Jack	133 19 32	2609.0	2853.1	1.62
			356 41 36	Single Tree	176 41 42	4969.9	5434.9	3.09
Hyne	31 12 13.46	81 19 16.01	110 41 23	Wylly	290 40 21	3389.0	3706.1	2.11
			72 58 29	Thomas	252 57 18	3822.0	4179.6	2.37
Gould's Cotton-house, south gable	31 11 08.31	81 21 57.33	353 34 17	Princess	173 34 24	3170.1	3466.7	1.97
			9 46 50	St. Simon's Main	189 46 32	5339.5	5839.1	3.32
Postell's House, east chimney	31 09 31.79	81 22 29.85	1 09 26	St. Simon's Main	181 09 25	2291.1	2505.5	1.42
			278 17 25	Princess	98 17 49	1228.4	1343.4	0.76
Barn, north gable	31 11 07.72	81 21 58.02	286 04 39	Single Tree	106 05 23	1821.1	1991.5	1.13
			14 25 09	Gould	194 25 00	1771.9	1937.7	1.10
Single tree in marsh	31 10 16.46	81 21 19.25	84 39 25	Gould	264 38 56	1474.8	1612.8	0.92
			22 51 03	Princess	202 50 50	1684.6	1842.2	1.05
Jekyl Main	31 05 59.16	81 23 55.14	194 50 32	St. Simon	14 50 51	3842.6	4202.1	2.39
			207 28 09	St. Simon's Main	27 28 52	4796.1	5244.9	2.98
East Base	31 08 09.02	81 23 54.66	286 19 22	St. Simon	106 19 41	1012.4	1107.1	0.63
			0 10 57	Jekyl Main	180 10 57	3998.9	4373.0	2.48
Dubignon	31 07 12.27	81 24 17.49	345 15 39	Jekyl Main	165 15 51	2327.8	2545.6	1.45
			227 07 44	St Simon	47 08 15	2150.8	2352.1	1.34
West Base	31 08 31.40	81 24 37.72	301 08 36	East Base	121 08 58	1332.5	1457.1	0.83
			347 35 59	Dubignon	167 36 09	2495.2	2728.7	1.55
Jekyl North	31 07 11.82	81 24 50.80	188 02 57	West Base	8 03 04	2475.2	2706.8	1.54
			220 10 03	East Base	40 10 32	2305.4	2521.1	1.43
Plantation	31 07 59.90	81 25 55.86	244 52 46	West Base	64 53 26	2285.9	2499.7	1.42
			310 39 39	Jekyl North	130 40 13	2272.0	2484.6	1.41
Brunswick Point	31 06 39.95	81 26 53.59	211 50 53	Plantation	31 51 23	2898.1	3169.3	1.80
			253 12 30	Jekyl North	73 13 33	3397.9	3715.8	2.11
Jekyl Creek	31 05 13.77	81 26 15.42	159 08 15	Brunswick Point	339 07 55	2840.2	3105.9	1.76
			211 39 30	Jekyl North	31 40 14	4271.9	4671.6	2.65
Cedar Hammock	31 06 12.14	81 28 27.88	251 03 09	Brunswick Point	71 03 58	2640.9	2888.0	1.64
			297 05 59	Jekyl Creek	117 07 07	3943.0	4312.0	2.45
Dennis Folly	31 07 31.20	81 29 03.57	294 36 24	Brunswick Point	114 37 31	3787.3	4141.7	2.35
			338 46 25	Cedar Hammock	158 46 44	2611.8	2856.2	1.62
Jointer	31 07 07.28	81 30 17.53	300 18 12	Cedar Hammock	120 19 09	3365.2	3680.1	2.09
			249 23 55	Dennis Folly	69 24 33	2093.2	2289.1	1.30
Brandy Point	31 07 57.30	81 29 43.27	307 23 30	Dennis Folly	127 23 51	1323.4	1447.2	0.82
			30 31 24	Jointer	210 31 06	1787.8	1955.1	1.11
Buzzard's Roost	31 08 47.95	81 30 59.10	307 49 49	Brandy Point	127 50 28	2543.2	2781.2	1.58
			340 26 44	Jointer	160 27 06	3289.7	3597.5	2.04

UNITED STATES COAST SURVEY—GEOGRAPHICAL POSITIONS.

Sapelo to St. Simon's Sound, including Altamuha Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Canal	31 09 43.86	81 29 51.54	356 10 35	Brandy Point	176 10 39	3288.6	3596.3	2.04
			46 06 33	Buzzard's Roost	226 05 58	2482.6	2714.9	1.54
Tall Tree	31 11 13.73	81 32 09.21	307 11 52	Canal	127 13 03	4576.6	5004.8	2.84
			337 31 32	Buzzard's Roost	157 32 08	4857.5	5312.0	3.02
St. Simon's Light-house	31 08 01.92	81 23 24.29	42 41 11	Dubignon	222 40 44	2079.2	2273.8	1.29
			105 14 54	East Base	285 14 38	834.1	912.2	0.52
Mackay	31 09 09.98	81 25 51.73	301 12 06	West Base	121 12 44	2291.6	2506.1	1.42
			2 54 28	Plantation Creek	182 54 26	2160.4	2362.5	1.34
Hamilton	31 09 51.61	81 24 34.37	1 59 54	West Base	181 59 52	2471.2	2702.4	1.54
			32 04 49	Plantation Creek	212 04 07	4059.6	4439.5	2.52
Old House	31 06 06.01	81 24 39.82	57 36 06	Jekyl Creek	237 35 17	3000.9	3281.7	1.86
			106 26 46	Brunswick Point	286 25 37	3695.9	4041.7	2.30
Collins	31 05 54.22	81 25 38.68	38 01 41	Jekyl Creek	218 01 22	1581.1	1729.0	0.98
			125 21 38	Brunswick Point	305 20 59	2434.3	2662.1	1.51
Lee	31 05 09.30	81 27 22.98	195 34 20	Brunswick Point	15 34 35	2898.7	3169.9	1.80
			265 34 37	Jekyl Creek	85 35 12	1795.5	1963.5	1.12
Miller	31 05 42.76	81 27 57.72	223 57 07	Brunswick Point	43 57 40	2447.3	2676.3	1.52
			288 12 44	Jekyl Creek	108 13 37	2853.7	3120.7	1.77
Patch	31 06 43.23	81 27 44.34	274 16 25	Brunswick Point	94 16 51	1347.9	1474.0	0.84
			50 18 25	Cedar Hammock	230 18 02	1499.5	1639.8	0.93
Nelson	31 06 50.40	81 29 07.20	105 35 21	Jointer	285 34 45	1934.5	2115.5	1.20
			184 22 34	Dennis Folly	4 22 36	1259.7	1377.6	0.78
Joe	31 07 12.37	81 28 28.74	86 53 47	Jointer	266 52 51	2886.4	3156.5	1.79
			125 01 33	Brandy Point	305 00 55	2410.5	2636.0	1.50
Helm's chimney	31 07 51.47	81 29 15.93	332 18 22	Dennis Folly	152 18 28	705.1	771.1	0.44
			50 10 44	Jointer	230 10 12	2124.5	2323.3	1.32
Baker	31 07 40.00	81 31 03.40	255 54 26	Brandy Point	75 55 07	2188.6	2393.4	1.36
			309 39 26	Jointer	129 39 50	1578.4	1726.1	0.98
Finney	31 07 59.79	81 30 47.51	272 34 33	Brandy Point	92 35 06	1703.8	1863.3	1.06
			333 49 58	Jointer	153 50 13	1801.3	1969.8	1.12
Parland's cupola	31 07 58.05	81 32 07.20	229 34 03	Buzzard's Roost	49 34 38	2369.8	2591.5	1.47
			270 20 23	Brandy Point	90 21 37	3812.7	4169.5	2.37
Dennison	31 08 08.02	81 29 25.16	55 26 17	Brandy Point	235 26 08	582.1	636.6	0.36
			116 18 44	Buzzard's Roost	276 17 55	2775.2	3034.9	1.72
Academy	31 08 51.20	81 29 14.53	24 37 33	Brandy Point	204 37 18	1826.2	1997.1	1.14
			87 56 13	Buzzard's Roost	267 55 19	2771.1	3030.4	1.72
Friedlander's Store	31 08 54.29	81 29 33.78	8 08 35	Brandy Point	188 08 30	1772.9	1938.8	1.10
			85 04 31	Buzzard's Roost	265 03 47	2267.9	2480.1	1.41
Gibson's flag	31 09 06.09	81 29 49.09	355 49 50	Brandy Point	175 49 53	2124.0	2322.8	1.32
			73 14 39	Buzzard's Roost	253 14 03	1936.3	2117.5	1.20
Upper Mill	31 09 24.67	81 29 42.54	0 24 05	Brandy Point	180 24 05	2690.5	2942.2	1.67
			60 51 39	Buzzard's Roost	240 50 59	2321.1	2538.3	1.44
Colonel	31 08 12.19	81 31 28.37	215 08 23	Buzzard's Roost	35 08 38	1347.0	1473.0	0.84
			279 20 45	Brandy Point	99 21 39	2821.5	3085.5	1.75
Scarlett	31 08 38.48	81 31 34.25	252 35 23	Buzzard's Roost	72 35 41	975.6	1066.9	0.61
			349 07 04	Colonel	169 07 07	824.4	901.5	0.51
Merideth	31 09 05.81	81 31 13.27	241 33 51	Canal	61 34 33	2461.1	2691.4	1.53
			325 39 53	Buzzard's Roost	145 40 00	665.6	727.9	0.41
Bowditch	31 09 32.78	81 31 16.04	261 19 13	Canal	81 19 57	2263.4	2475.2	1.41
			341 59 14	Buzzard's Roost	161 59 23	1451.1	1586.9	0.90
Hein	31 09 56.40	81 31 11.45	280 20 26	Canal	100 21 07	2150.8	2352.1	1.34
			351 10 47	Buzzard's Roost	171 10 53	2132.8	2332.4	1.33
Osgood's flag	31 10 04.89	81 31 51.12	281 33 03	Canal	101 34 05	3232.0	3534.4	2.01
			329 48 50	Buzzard's Roost	149 49 17	2740.5	2996.9	1.70
King's Cotton-mill	31 08 23.56	81 24 10.64	25 43 25	Jekyl North	205 43 04	2452.0	2681.5	1.52
			53 32 53	Brunswick Point	233 31 29	5367.8	5870.0	3.34
Oglethorp House	31 08 01.10	81 29 34.78	6 31 33	Brandy Point	186 31 29	1976.7	2161.6	1.23
			79 45 23	Buzzard's Roost	259 44 39	2269.3	2481.7	1.41

UNITED STATES COAST SURVEY.—GEOGRAPHICAL DIVISIONS.

Section V.—St. Simon's Island to Jekyl and Cumberland Islands, including St. Simon's and St. Andrew's Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ′		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Troup	31 17 42.14	81 24 39.16	198 46 01	My Hall	18 46 53	8205.2	8973.0	5.10
			270 39 30	Butler	90 41 36	6446.6	7049.8	4.00
Bank	31 16 10.43	81 22 10.50	173 03 57	My Hall	353 03 32	10671.1	11669.6	6.63
			125 42 12	Troup	305 40 55	4840.8	5293.8	3.01
Brown	31 15 40.69	81 25 25.53	198 09 05	Troup	18 09 29	3936.2	4304.5	2.45
			259 55 06	Bank	79 56 47	5239.5	5729.8	3.26
West Point	31 14 07.95	81 23 22.00	162 48 46	Troup	342 48 06	6904.7	7550.7	4.29
			131 09 29	Brown	311 08 25	4340.2	4746.3	2.70
Duck	31 13 06.84	81 26 50.57	205 23 49	Brown	25 24 33	5244.8	5735.5	3.26
			251 09 28	West Point	71 11 16	5831.1	6376.7	3.62
Hamilton	31 09 51.61	81 24 34.37	172 49 29	Brown	352 49 02	10834.6	11848.4	6.73
			149 03 30	Duck	329 02 20	7010.2	7666.1	4.36
Curlew	31 08 16.54	81 28 34.46	197 05 41	Duck	17 06 35	9353.4	10228.6	5.81
			245 15 28	Hamilton	65 17 32	7000.0	7655.0	4.35
Raft	31 05 43.69	81 25 48.97	137 02 36	Curlew	317 01 10	6432.4	7034.3	4.00
			194 30 20	Hamilton	14 30 59	7886.2	8624.1	4.90
Mud	31 04 48.03	81 29 35.08	194 02 30	Curlew	14 03 01	6618.6	7237.9	4.11
			254 01 19	Raft	74 03 16	6232.7	6815.9	3.87
Oak	31 01 53.91	81 30 01.80	187 31 25	Mud	7 31 39	5408.6	5914.7	3.36
			223 25 41	Raft	43 27 51	9746.2	10658.2	6.06
Cemetery	31 01 19.40	81 25 49.10	137 00 56	Mud	316 59 00	8784.9	9607.0	5.46
			99 01 47	Oak	278 59 37	6785.1	7420.0	4.22
Dover	30 58 44.41	81 29 17.12	168 31 24	Oak	348 31 01	5954.6	6511.7	3.70
			229 07 42	Cemetery	49 09 29	7295.7	7978.3	4.53
Deformed	30 57 23.87	81 26 27.87	118 55 14	Dover	298 53 47	5130.3	5610.3	3.19
			188 04 13	Cemetery	8 04 33	7325.3	8010.7	4.55
Mound	30 55 30.16	81 30 17.26	194 56 08	Dover	14 56 39	6191.0	6770.3	3.85
			240 04 46	Deformed	60 06 44	7023.6	7680.8	4.36
Bat	30 52 55.16	81 27 49.53	167 48 26	Dover	347 47 41	11003.0	12032.5	6.84
			140 35 43	Mound	320 34 27	6178.0	6756.0	3.84
Delaroche	30 50 59.38	81 30 43.82	184 50 01	Mound	4 50 15	8368.0	9150.9	5.20
			232 23 15	Bat	52 24 44	5843.4	6390.1	3.63
Wilson	31 17 07.67	81 22 08.73	171 23 55	My Hall	351 23 29	8930.6	9766.3	5.55
			1 31 09	Bank	181 31 08	1763.5	1928.5	1.10
Potato	31 15 26.37	81 22 17.40	138 07 33	Troup	318 06 19	5616.1	6141.6	3.49
			95 04 28	Brown	275 02 51	4996.4	5463.9	3.10
Ditch	31 16 49.83	81 22 47.15	246 13 04	Butler	66 14 12	3807.5	4163.8	2.37
			118 32 46	Troup	298 31 48	3371.8	3687.3	2.09
Beacon 11	31 17 33.35	81 23 28.65	185 31 02	My Hall	5 31 17	8077.0	8832.7	5.02
			98 16 16	Troup	278 15 39	1884.4	2060.7	1.17
Forman's House, east chimney	31 16 21.24	81 25 28.62	273 37 18	Bank	93 39 01	5250.9	5742.2	3.26
			207 41 52	Troup	27 42 18	2813.9	3077.2	1.75
Forman	31 16 24.22	81 24 57.93	191 41 28	Troup	11 41 18	2450.4	2679.7	1.52
			28 34 11	Brown	208 33 57	1526.6	1669.4	0.95
Post	31 13 35.99	81 23 45.89	145 32 17	Brown	325 31 25	4658.1	5094.0	2.89
			79 36 14	Duck	259 34 38	4969.1	5434.1	3.09
Goose	31 15 15.13	81 23 04.09	150 57 31	Troup	330 56 42	5178.8	5663.4	3.22
			101 53 26	Brown	281 52 13	3823.7	4181.4	2.38
John	31 14 44.64	81 24 07.44	313 13 11	West Point	133 13 35	1649.8	1804.2	1.02
			129 52 37	Brown	309 51 56	2692.0	2943.9	1.67
Boyce	31 15 32.97	81 23 56.39	164 07 32	Troup	344 07 10	4135.7	4522.6	2.57
			340 49 58	West Point	160 50 16	2771.6	3031.0	1.72
Sambo	31 16 13.47	81 23 22.74	143 29 43	Troup	323 29 03	3397.4	3715.3	2.11
			359 42 41	West Point	179 42 41	3865.5	4227.2	2.40
Shine's Mill, chimney	31 22 06.87	81 26 01.99	313 36 05	Butler	133 38 55	11926.4	13042.3	7.41
			344 57 39	Troup	164 58 22	8441.4	9231.2	5.25
Charcoal	31 16 14.57	81 22 01.55	122 54 51	Troup	302 53 29	4964.9	5429.5	3.08
			220 59 59	Butler	41 00 44	3472.8	3797.8	2.16

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section V.—St. Simon's Island to Jekyl and Cumberland Islands, including St. Simon's and St. Andrew's Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Hazard	31 14 36.23	81 22 58.38	155 02 15	Troup	335 01 23	6315.3	6906.2	3.92
			117 01 43	Brown	297 00 27	4369.8	4778.7	2.71
Winnowing House, centre	31 21 54.43	81 25 27.77	315 24 32	Butler	135 27 04	11012.6	12043.1	6.84
			350 36 27	Troup	170 36 52	7874.8	8611.6	4.89
Stevens	31 12 57.63	81 23 50.26	199 02 35	West Point	19 02 50	2291.1	2505.5	1.42
			93 24 51	Duck	273 23 17	4780.4	5227.7	2.97
Smack	31 11 31.11	81 25 07.49	137 13 12	Duck	317 12 18	4016.7	4392.5	2.50
			344 01 42	Hamilton	164 01 59	3186.9	3485.1	1.98
Peter	31 10 12.43	81 26 46.14	38 47 51	Curlew	218 46 55	4579.0	5007.4	2.85
			280 23 49	Hamilton	100 24 57	3547.4	3879.3	2.20
Pitch	31 09 47.11	81 28 19.91	268 39 15	Hamilton	88 41 12	5973.8	6532.8	3.71
			7 51 32	Curlew	187 51 24	2815.7	3079.1	1.75
Creek	31 13 02.42	81 25 30.24	345 52 08	Hamilton	165 52 37	6059.1	6626.1	3.76
			181 27 52	Brown	1 27 54	4875.4	5331.6	3.03
House at Frederica, chimney	31 13 25.42	81 23 22.63	142 02 02	Brown	322 00 58	5284.4	5778.9	3.28
			16 05 44	Hamilton	196 05 07	6852.5	7493.7	4.26
Troup's House, cupola	31 12 41.49	81 27 23.13	13 02 04	Curlew	193 01 27	8375.3	9159.0	5.20
			247 19 55	West Point	67 22 00	6914.1	7561.1	4.30
Bull	31 13 56.21	81 26 20.10	27 56 41	Duck	207 56 25	1720.8	1881.8	1.07
			204 09 39	Brown	24 10 07	3526.5	3856.5	2.19
Border	31 11 51.83	81 23 41.69	114 48 36	Duck	294 46 58	5507.0	6022.2	3.42
			20 38 59	Hamilton	200 38 32	3956.0	4326.2	2.46
White chimney at Hamilton	31 10 27.18	81 24 12.37	139 35 20	Duck	319 33 58	6458.3	7062.6	4.01
			191 05 26	West Point	11 05 52	6927.9	7576.1	4.30
George	31 14 39.51	81 25 03.90	163 06 01	Brown	343 05 50	1969.1	2153.4	1.22
			44 41 25	Duck	224 40 30	4013.7	4389.2	2.49
Dubignon's House, south chimney	31 03 57.47	81 25 13.65	146 19 30	Curlew	326 17 46	9587.6	10484.7	5.96
			63 32 52	Oak	243 30 23	8534.7	9333.2	5.30
Grass	31 03 02.24	81 26 23.50	122 41 19	Mud	302 39 40	6033.0	6597.5	3.75
			70 02 37	Oak	250 00 44	6158.5	6734.8	3.83
Little	31 01 29.30	81 27 02.21	193 55 01	Raft	13 55 39	8070.5	8825.6	5.01
			278 55 37	Cemetery	98 56 15	1962.4	2146.0	1.22
Snail	31 00 27.86	81 29 09.74	253 22 39	Cemetery	73 24 22	5553.1	6072.7	3.45
			3 31 10	Dover	183 31 06	3191.6	3490.3	1.98
Satilla	31 02 16.97	81 28 31.88	214 08 37	Raft	34 10 01	7691.9	8411.7	4.78
			160 11 35	Mud	340 11 02	4945.0	5407.7	3.07
River	31 03 39.68	81 28 51.09	150 59 46	Mud	331 00 09	2406.0	2631.2	1.50
			311 49 13	Cemetery	131 50 47	6476.7	7082.7	4.02
Spar	30 59 55.64	81 27 28.59	225 39 04	Cemetery	45 39 55	3689.8	4035.0	2.29
			340 58 37	Deformed	160 59 08	4943.2	5405.7	3.07
St. Andrew's Light	30 58 33.91	81 24 34.25	158 43 15	Cemetery	338 42 36	5469.2	5981.0	3.40
			54 25 34	Deformed	234 24 36	3707.0	4053.8	2.30
Turtle	31 03 05.47	81 27 40.28	136 03 49	Mud	316 02 50	4386.0	4796.4	2.73
			317 55 07	Cemetery	137 56 04	4400.2	4811.9	2.74
Crab	30 56 46.19	81 25 09.73	172 55 20	Cemetery	352 55 00	8478.2	9271.5	5.27
			74 00 51	Mound	253 58 13	8491.2	9285.7	5.28
Bluff	30 55 34.45	81 26 53.23	146 52 27	Dover	326 51 13	6985.9	7639.5	4.34
			88 36 51	Mound	268 35 06	5417.9	5924.8	3.37
Horse	30 57 31.79	81 28 44.01	273 50 55	Deformed	93 52 05	3621.0	3959.8	2.25
			213 29 35	Cemetery	33 31 05	8405.8	9192.3	5.22
Floyd's House, north chimney	30 56 59.18	81 30 22.10	183 23 34	Oak	3 23 44	9091.3	9941.9	5.65
			222 05 22	Cemetery	42 07 42	10801.2	11811.9	6.71
Board	31 01 04.96	81 25 20.86	14 38 24	Deformed	194 37 49	7036.3	7694.7	4.37
			57 47 58	Spar	237 46 52	4004.1	4378.8	2.49
Buoy in St. Andrew's Sound	30 59 47.62	81 25 08.00	171 52 45	Board	351 52 38	2405.6	2630.7	1.49
			25 35 56	Deformed	205 35 15	4907.0	5366.1	3.05
Sand	31 02 07.67	81 24 39.48	358 47 40	St. Andrew's Light	178 47 43	6584.0	7200.1	4.09
			18 13 11	Deformed	198 12 15	9200.3	10061.1	5.72
Club	30 55 51.60	81 26 15.84	128 07 30	Horse	308 06 14	4998.3	5466.0	3.11
			173 35 22	Deformed	353 35 16	2859.3	3126.9	1.78

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section V.—St. Simon's Island to Jekyl and Cumberland Islands, including St. Simon's and St. Andrew's Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Conch	30 57 10.78	81 24 25.19	50 18 24	Club	230 17 27	3817.2	4174.4	2.37
			97 03 57	Deformed	277 02 54	3280.7	3587.7	2.04
Hog	30 54 38.80	81 24 30.59	181 45 45	Conch	1 45 48	4681.4	5119.4	2.91
			165 09 37	Crab	345 09 17	4058.9	4438.7	2.52
Harry	30 55 51.86	81 28 33.03	76 25 44	Mound	256 24 50	2846.5	3112.8	1.77
			229 31 31	Deformed	49 32 35	4365.5	4774.0	2.71
Southernmost of Downe's negro houses, chimney.	30 53 54.20	81 26 27.00	50 19 54	Bat	230 19 12	2847.4	3113.8	1.77
			51 44 10	Delaroche	231 41 58	8689.4	9502.5	5.40
Decay	30 51 40.42	81 27 43.73	75 12 47	Delaroche	255 11 15	4948.2	5411.2	3.07
			150 03 20	Mound	330 02 01	8165.0	8929.0	5.07
Stafford	30 49 13.99	81 28 05.79	127 42 43	Delaroche	307 41 22	5306.9	5803.4	3.30
			183 37 48	Bat	3 37 57	6824.3	7462.8	4.24
Beacon 1	30 50 53.71	81 28 29.28	195 45 40	Bat	15 46 00	3886.3	4249.9	2.41
			348 30 33	Stafford	168 30 45	3133.3	3426.5	1.95
Beacon 2	30 50 12.98	81 28 56.60	116 38 35	Delaroche	296 37 40	3187.0	3485.2	1.98
			199 37 53	Bat	19 38 27	5302.3	5798.4	3.29
Beacon 3	30 49 43.12	81 29 18.54	294 53 16	Stafford	114 53 53	2131.2	2330.6	1.32
			136 01 52	Delaroche	316 01 08	3263.2	3568.5	2.03
Beacon 4	30 48 38.18	81 29 09.90	195 05 45	Bat	15 06 26	8196.6	8963.5	5.09
			150 09 07	Delaroche	330 08 19	5013.3	5482.4	3.11
Beacon 5	30 46 49.94	81 28 57.05	159 43 53	Delaroche	339 42 58	8188.3	8954.5	5.09
			197 04 15	Stafford.	17 04 41	4640.3	5074.5	2.88
Beacon 6	30 45 34.96	81 29 01.88	164 49 58	Delaroche	344 49 06	10350.8	11319.3	6.43
			192 27 46	Stafford	12 28 15	6907.6	7553.9	4.29
Beacon on Shoal	30 53 23.67	81 30 22.31	7 19 29	Delaroche	187 19 18	4479.9	4899.1	2.78
			181 57 51	Mound	1 57 54	3897.3	4262.0	2.42
Carvin	30 52 02.51	81 29 35.34	170 07 40	Mound	350 07 18	6490.4	7097.7	4.03
			240 00 40	Bat	60 01 34	3244.7	3548.3	2.02
Augusta	30 51 33.26	81 29 11.05	67 03 49	Delaroche	247 03 01	2676.1	2926.5	1.66
			220 38 34	Bat	40 39 16	3324.1	3635.1	2.07
Forsaken	30 47 35.94	81 30 26 84	175 52 49	Delaroche	355 52 40	6280.9	6868.6	3.90
			231 08 28	Stafford	51 09 40	4813.3	5263.7	2.99
Nightingale	30 46 03.88	81 27 59.19	125 50 42	Forsaken	305 49 27	4841.8	5294.9	3.01
			178 16 57	Stafford	* 358 16 53	5856.5	6404.5	3.64
Camden	30 45 30.85	81 30 14.22	175 01 30	Forsaken	355 01 23	3866.4	4228.2	2.40
			254 10 25	Nightingale	74 11 34	3731.9	4081.1	2.32
Sector	30 44 15.12	81 28 44.63	134 23 17	Camden	314 22 32	3334.1	3646.1	2.07
			199 50 05	Nightingale	19 50 28	3560.4	3893.5	2.21
Point Peter	30 43 38.26	81 30 30.23	187 00 05	Camden	7 00 13	3493.0	3819.9	2.17
			247 59 33	Sector	68 00 27	3029.7	3313.2	1.88
North Base	30 42 30.24	81 28 41.23	125 50 48	Point Peter	305 49 52	3577.2	3911.9	2.22
			178 23 47	Sector	358 23 45	3230.7	3533.0	2.01
Martin's Island	30 41 15.50	81 30 51.90	236 29 24	North Base	56 30 31	4169.6	4559.7	2.59
			187 28 05	Point Peter	7 28 16	4433.6	4848.4	2.76
South Base	30 41 42.24	81 28 15.85	78 47 20	Martin's Island	258 46 01	4233.4	4629.5	2.63
			134 59 03	Point Peter	314 57 54	5053.9	5526.8	3.14
Dungeness, southeast chimney	30 44 53.82	81 28 02.49	59 22 49	Point Peter	239 21 33	4567.0	4994.3	2.84
			108 02 01	Camden	288 00 54	3684.2	4028.9	2.29
Rest	30 44 48.16	81 27 28.48	63 19 08	Sector	243 18 29	2266.7	2478.8	1.41
			100 53 55	Dungeness, SE. chimney	280 53 38	921.1	1007.3	0.57
Stafford's House, south chimney	30 48 54.57	81 27 51.27	31 12 49	Camden	211 11 36	7334.9	8021.3	4.56
			59 39 02	Forsaken	239 37 42	4791.8	5240.2	2.98
Beacon No. 6	30 45 22.09	81 28 57 87	150 08 59	Forsaken	330 08 14	4751.8	5196.5	2.95
			230 29 11	Nightingale	50 29 41	2022.2	2211.4	1.26
Old House, south chimney	30 48 03.73	81 30 52.54	243 58 31	Stafford	63 59 56	4931.6	5393.1	3.06
			308 40 39	Nightingale	128 42 08	5904.6	6457.1	3.67
Pelican	30 46 14.16	81 27 23.87	2 38 20	Rest	182 38 18	2650.3	2898.3	1.65
Porpoise	30 47 51.34	81 27 00.12	11 55 24	Pelican	191 55 12	3058.3	3344.5	1.90
Shark	30 50 17.24	81 25 49.30	22 44 20	Porpoise	202 43 44	4781.0	5228.4	2.97

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section V.—St. Simon's Island to Jekyl and Cumberland Islands, including St. Simon's and St. Andrew's Sound.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Mullet	30 51 24.87	81 25 09.22	27 05 19	Shark	207 04 58	2338.9	2557.7	1.45
Palmetto	30 52 43.21	81 24 41.45	17 00 28	Mullet	197 00 14	2522.7	2758.8	1.57
Trout	30 54 20.58	81 24 20.95	10 17 52	Palmetto	190 17 41	3048.8	3334.0	1.89
			178 46 35	Couch	358 46 33	5242.3	5732.8	3.26

Section VI.—Cumberland Sound to St. John's River.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
Tiger Island Base, North End	30 42 30.24	81 28 41.23	....	....	....	....	....	.....
Tiger Island Base, South End	30 41 42.24	81 28 15.85	155 26 38	North Base	335 26 25	1624.7	1776.7	1.01
Cumberland	30 43 23.23	81 27 34.62	47 22 12	North Base	227 21 38	2408.8	2634.2	1.50
			19 26 20	South Base	199 25 59	3297.2	3605.7	2.05
Point Peter	30 43 38.26	81 30 30.23	314 57 54	South Base	134 59 03	5054.8	5527.7	3.14
			275 39 02	Cumberland	95 40 32	4695.2	5134.5	2.92
Martin's Island	30 41 15.50	81 30 51.90	233 08 36	Cumberland	53 10 17	6559.7	7173.5	4.08
			187 28 05	Point Peter	7 28 16	4434.3	4849.2	2.76
Clarke	30 39 52.21	81 30 06.94	221 06 02	South Base	41 06 59	4496.9	4917.6	2.79
			154 59 40	Martin's Island	334 59 17	2829.7	3094.5	1.76
Jackson	30 39 15.71	81 28 20.47	181 33 38	South Base	1 33 40	4513.9	4936.3	2.81
			111 38 17	Clarke	291 37 23	3049.1	3334.4	1.89
Pine Island	30 38 01.93	81 29 21.29	160 18 26	Clarke	340 18 03	3606.5	3943.9	2.24
			215 28 40	Jackson	35 29 11	2789.6	3050.6	1.73
Amelia	30 36 58.45	81 28 10.70	176 28 43	Jackson	356 28 38	4234.5	4630.7	2.63
			136 07 47	Pine Island	316 07 11	2712.1	2965.9	1.69
Harrison	30 36 05.86	81 29 09.46	174 57 45	Pine Island	354 57 39	3588.0	3923.7	2.23
			224 01 06	Amelia	44 01 36	2251.8	2462.5	1.40
Vaughan	30 35 20.07	81 28 02.96	128 31 44	Harrison	308 31 10	2263.9	2475.8	1.41
			176 06 34	Amelia	356 06 30	3036.3	3320.4	1.89
Sterett	30 34 23.56	81 29 07.51	179 03 10	Harrison	359 03 09	3150.3	3445.0	1.96
			224 39 22	Vaughan	44 39 55	2446.0	2674.9	1.52
McRory	30 33 31.81	81 27 38.17	123 48 12	Sterett	303 47 26	2864.5	3132.5	1.78
			168 47 19	Vaughan	348 47 06	3398.1	3716.1	2.11
Nassau	30 32 41.59	81 28 44.34	168 52 40	Sterett	348 52 28	3200.2	3499.6	1.99
			228 44 22	McRory	48 44 56	2345.6	2565.0	1.46
Shell Bank	30 31 45.05	81 26 58.38	121 39 18	Nassau	301 38 24	3317.5	3627.9	2.06
			162 07 24	McRory	342 07 04	3454.2	3777.4	2.15
Anderson	30 31 36.73	81 28 03.68	151 31 06	Nassau	331 30 45	2272.3	2484.9	1.41
			190 51 28	McRory	10 51 41	3608.5	3946.1	2.24
Crane	30 30 31.92	81 28 01.53	178 21 15	Anderson	358 21 14	1996.4	2183.2	1.24
			216 46 24	Shell Bank	36 46 56	2811.8	3074.9	1.75
Christopher	30 30 11.40	81 27 12.40	115 44 49	Crane	295 44 24	1454.0	1590.1	0.90
			187 23 13	Shell Bank	7 23 20	2907.8	3179.8	1.81
South	30 30 46.45	81 26 01.65	82 01 56	Crane	262 00 55	3227.4	3529.4	2.01
			140 02 01	Shell Bank	320 01 32	2354.3	2574.6	1.46
Braddock	30 29 29.76	81 27 50.74	171 27 12	Crane	351 27 06	1935.0	2116.1	1.20
			218 33 58	Christopher	38 34 18	1639.6	1793.0	1.02
Skeleton	30 28 55.44	81 26 35.90	117 55 02	Braddock	297 54 24	2258.4	2469.7	1.40
			157 24 43	Christopher	337 24 25	2533.5	2770.5	1.57
Breward	30 27 44.60	81 27 34.28	172 16 51	Braddock	352 16 42	3267.7	3573.4	2.03
			215 31 08	Skeleton	35 31 37	2679.5	2930.2	1.66
George	30 26 42.33	81 26 25.79	136 23 43	Breward	316 23 08	2648.7	2896.5	1.65
			176 14 11	Skeleton	356 14 06	4107.6	4491.9	2.55
Horseshoe	30 26 03.74	81 27 17.80	171 57 03	Breward	351 56 55	3136.6	3430.1	1.95
			229 26 07	George	49 26 33	1826.9	1997.8	1.14
Round Pond	30 24 50.02	81 25 57.04	136 29 26	Horseshoe	316 28 45	3130.0	3422.9	1.95
			167 29 48	George	347 29 33	3541.7	3873.1	2.20

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VI.—Cumberland Sound to St. John's River.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Amelia Island, chimney of house	30 37 28.70	81 28 07.87	4 37 13	Amelia	184 37 12	934.8	1022.2	0.58
			117 38 03	Pine Island	297 37 26	2206.5	2413.0	1.37
West Gable of House at railroad bridge.	30 37 43.07	81 28 52.90	127 32 28	Pine Island	307 32 13	953.5	1042.7	0.59
			196 50 10	Jackson	16 50 26	2980.3	3259.1	1.85
Chimney of House near railroad on Pine Island.	30 37 24.33	81 29 26.63	207 10 57	Jackson	27 11 31	3855.7	4216.4	2.40
			329 46 32	Vaughan	149 47 15	4431.2	4845.8	2.75
E. Harrison's House, south chimney.	30 36 29.15	81 29 31.03	200 06 45	Jackson	20 07 21	5462.0	5973.1	3.39
			312 11 50	Vaughan	132 12 35	3166.4	3462.7	1.96
West Gable of House on Amelia Island.	30 38 32.08	81 28 00.59	66 38 39	Pine Island	246 37 58	2340.3	2559.2	1.45
			158 30 21	Jackson	338 30 11	1444.0	1579.1	0.90
Bird Nest Tree on Crane Island	30 36 38.37	81 28 28.42	151 18 58	Pine Island	331 18 31	2933.2	3207.7	1.82
			344 17 56	Vaughan	164 18 09	2504.7	2739.0	1.56
Sterett's House, chimney	30 33 54.50	81 29 40.02	224 03 49	Sterett	44 04 06	1245.7	1362.2	0.77
			282 07 45	McRory	102 08 47	3321.4	3632.1	2.06
Stake with cow's head	30 35 34.62	81 28 40.37	294 12 29	Vaughan	114 12 48	1092.5	1194.7	0.68
			141 09 16	Harrison	321 09 01	1235.2	1350.8	0.77
Bird Nest Tree on Amelia Island	30 34 35.46	81 27 11.77	83 13 45	Sterett	263 12 46	3105.1	3395.7	1.93
			19 44 30	McRory	199 44 17	2082.1	2276.9	1.29
Mrs. Vaughan's House, chimney	30 35 01.34	81 27 11.69	14 21 30	McRory	194 21 17	2845.4	3111.6	1.77
			69 21 15	Sterett	249 20 16	3297.4	3605.9	2.05
Old Tree	30 30 14.63	81 26 44.33	140 04 49	Anderson	320 04 09	3296.1	3604.5	2.05
			229 15 55	South	49 16 17	1501.8	1642.3	0.93
Thorn	30 32 44.25	81 26 13.67	54 39 54	Anderson	234 38 58	3594.6	3930.9	2.23
			88 50 19	Nassau	268 49 02	4016.4	4392.2	2.50
Pine	30 33 06.60	81 26 49.77	35 26 58	Anderson	215 26 20	3397.0	3714.8	2.11
			75 50 58	Nassau	255 50 00	3149.0	3443.6	1.96
Concave	30 33 46.26	81 26 23.21	352 24 17	Thorn	172 24 22	1926.1	2106.4	1.20
			30 05 21	Pine	210 05 08	1411.4	1543.4	0.88
Browne	30 34 21.84	81 26 25.68	356 34 05	Concave	176 34 06	1097.6	1200.3	0.68
Spar	30 36 02.03	81 26 24.29	0 41 01	Browne	180 41 00	3085.0	3373.7	1.92
Briggs	30 37 48.00	81 26 09.34	6 57 36	Spar	186 57 28	3287.4	3595.0	2.04
Bryant	30 39 44.72	81 25 33.47	14 53 02	Briggs	194 52 44	3719.0	4066.9	2.31
Scramble	30 28 48.26	81 26 10.29	137 06 18	Crane	317 05 22	4357.4	4765.1	2.71
			48 49 15	Breward	228 48 32	2976.5	3255.0	1.85
Palmetto on northeast point of Talbot's Island.	30 29 21.68	81 25 46.84	156 38 32	Shell Bank	336 37 56	4808.9	5258.8	2.99
			171 24 32	South	351 24 24	2639.9	2886.9	1.64
Tyson's House, chimney	30 30 17.21	81 28 07.00	214 03 52	Shell Bank	34 04 27	3265.3	3570.8	2.03
			197 53 08	Crane	17 53 11	475.8	520.3	0.30
Briar	30 28 54.75	81 24 35.39	146 14 40	South	326 13 56	4137.9	4525.0	2.57
			143 59 13	Shell Bank	323 58 00	6483.5	7090.1	4.03
Single Tree	30 26 39.41	81 27 32.16	178 23 04	Breward	358 23 03	2008.3	2196.2	1.25
			199 42 47	Skeleton	19 43 16	4449.3	4865.7	2.76
Gibb's	30 26 23.58	81 26 03.07	356 48 14	Round Pond	176 48 17	2885.2	3155.2	1.79
			72 58 27	Horseshoe	252 57 49	2085.5	2280.6	1.30
Mount Cornelia	30 25 54.48	81 25 24.10	23 53 43	Round Pond	203 53 27	2170.5	2373.5	1.35
			95 22 48	Horseshoe	275 21 50	3047.4	3332.5	1.89
Little Talbot	30 27 14.76	81 25 00.92	14 02 56	Mount Cornelia	194 02 44	2547.6	2786.0	1.58
			59 06 14	Horseshoe	239 05 05	4256.3	4654.6	2.65
Houston's House, north chimney	30 27 49.02	81 26 09.76	29 15 29	Horseshoe	209 14 54	3714.8	4062.3	2.31
			299 52 16	Little Talbot	119 52 51	2117.8	2315.9	1.32
St. John's River.								
Sand Hill 3	30 23 30.54	81 25 37.07	167 43 00	Round Pond	347 42 50	2504.7	2739.0	1.56
Base, East End	30 24 23.46	81 24 37.87	111 10 06	Round Pond	291 09 26	2265.9	2477.9	1.41
			156 14 38	Mount Cornelia	336 14 15	3062.1	3348.6	1.90
Base, West End	30 24 16.57	81 25 14.80	257 52 27	East Base	77 52 46	1008.1	1102.5	0.63
			22 45 26	Sand Hill 3	202 45 15	1537.3	1681.2	0.96
Sand Hill 1	30 23 36.73	81 24 14.98	157 00 07	East Base	336 59 56	1563.0	1709.3	0.97
			127 33 05	West Base	307 32 35	2013.5	2201.9	1.25
Sand Hill 2	30 23 42.42	81 24 46.77	144 35 22	West Base	324 35 08	1290.5	1411.2	0.80
			281 39 58	Sand Hill 1	101 40 14	866.5	947.6	0.54

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VI.—St. John's River.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
St. John's Point	30 23 19.89	81 23 41.64	111 45 57	Sand Hill 2	291 45 24	1871.9	2047.1	1.16
			142 31 51	East Base	322 31 23	2466.5	2697.3	1.53
St. John's Light	30 23 39.96	81 24 40.17	79 12 16	Sand Hill 3	259 11 47	1546.3	1691.0	0.96
			140 40 20	West Base	320 40 03	1485.2	1624.2	0.92
Mayport Mills	30 23 21.04	81 25 45.51	223 12 25	East Base	43 12 59	2637.2	2884.0	1.64
			205 36 28	West Base	25 36 44	1896.5	2073.9	1.18
Black House	30 23 56.03	81 25 53.10	238 14 33	West Base	58 14 52	1202.5	1315.0	0.75
			247 11 03	East Base	67 11 41	2178.5	2382.3	1.35
Pilot's Lookout	30 24 01.76	81 25 48.19	250 23 53	East Base	70 24 29	1992.2	2178.6	1.24
			242 52 44	West Base	62 53 01	1001.4	1095.1	0.62
Old Derrick	30 26 11.15	81 24 46.58	168 57 01	Little Talbot	348 56 54	1995.3	2182.0	1.24
			355 59 05	East Base	175 59 09	3323.8	3634.8	2.07
Big Sister	30 24 00.67	81 27 12.64	202 52 06	Gibbs	22 52 41	4776.1	5223.0	2.97
			233 00 12	Round Pond	53 00 50	2525.9	2762.2	1.57
Sister	30 24 00.38	81 27 13.20	289 41 32	Sand Hill 3	109 42 21	2725.3	2980.3	1.69
			178 08 47	Horseshoe	358 08 45	3800.7	4156.4	2.36
Mount Pleasant	30 22 03.42	81 27 41.25	191 44 37	Sister	11 44 51	3678.2	4022.4	2.28
			231 00 42	Sand Hill 3	51 01 45	4264.4	4663.4	2.65
Pilot	30 25 16.47	81 30 08.59	252 16 14	Horseshoe	72 17 41	4783.8	5231.5	2.97
			296 34 39	Sister	116 36 08	5234.3	5724.1	3.25
St. John's Bluff	30 23 21.77	81 29 14.51	249 49 44	Sister	69 50 45	3449.3	3772.1	2.14
			211 58 25	Horseshoe	31 59 24	5880.2	6430.4	3.65
Batten Island	30 24 41.66	81 24 48.05	358 56 20	Sand Hill 2	178 56 21	1824.2	1994.9	1.13
			30 52 04	Sand Hill 3	210 51 39	2551.0	2789.7	1.59
Palmer	30 22 04.83	81 24 46.78	153 02 27	Sand Hill 3	333 02 02	2960.8	3237.9	1.84
			180 00 18	Sand Hill 2	0 00 18	3004.8	3285.9	1.87
Haynes	30 21 42.37	81 26 35.51	205 05 34	Sand Hill 3	25 06 04	3678.1	4022.3	2.28
			256 35 15	Palmer	76 36 10	2984.2	3263.4	1.85
Pine Island	30 20 26.12	81 25 49.29	152 19 28	Haynes	332 19 05	2651.3	2899.4	1.65
			208 48 22	Palmer	28 48 54	3469.0	3793.5	2.15
Haynes' Cotton House, east end	30 21 05.75	81 26 37.43	313 33 44	Pine Island	133 34 08	1770.4	1936.0	1.10
			182 36 34	Haynes	2 36 35	1128.9	1234.5	0.70
Palmetto	30 23 20.34	81 31 04.41	269 07 49	St. John's Bluff	89 08 45	2934.0	3208.6	1.82
			202 36 49	Pilot	22 37 17	3873.9	4236.4	2.41
Brown's Island	30 25 20.13	81 31 49.22	342 02 00	Palmetto	162 02 23	3877.8	4240.6	2.41
			272 23 48	Pilot	92 24 39	2687.7	2939.2	1.67
Dame's Point	30 23 14.82	81 33 14.53	210 32 20	Brown's Island	30 33 03	4480.2	4899.4	2.78
			267 11 36	Palmetto	87 12 42	3477.6	3803.0	2.16
Bird Island	30 22 15.01	81 32 09.30	136 36 13	Dame's Point	316 35 40	2534.7	2771.8	1.57
			220 43 51	Palmetto	40 44 24	2654.4	2902.8	1.65
Mitchell	30 22 14.29	81 33 33.84	195 27 15	Dame's Point	15 27 25	1933.6	2114.5	1.20
			269 26 13	Bird Island	89 26 56	2257.3	2468.5	1.40
Newcastle	30 22 50.33	81 34 59.78	254 57 48	Dame's Point	74 58 41	2908.7	3180.8	1.81
			295 48 09	Mitchell	115 48 52	2548.3	2786.8	1.58
Balsan	30 23 45.28	81 33 51.00	350 42 36	Mitchell	170 42 45	2838.5	3104.1	1.76
			47 20 25	Newcastle	227 19 50	2496.4	2730.0	1.55
Cedar Creek	30 24 54.69	81 35 20.07	311 57 25	Balsan	131 58 10	3196.9	3496.0	1.99
			351 56 46	Newcastle	171 56 56	3867.6	4229.5	2.40
Broward	30 23 51.60	81 37 27.74	240 17 56	Cedar Creek	60 19 01	3922.3	4289.3	2.44
			295 31 16	Newcastle	115 32 31	4377.2	4786.8	2.72
Reddie 1	30 23 23.66	81 36 34.93	121 24 07	Broward	301 23 40	1651.4	1805.9	1.03
			215 28 27	Cedar Creek	35 29 05	3442.4	3764.5	2.14
Sandfly Point	30 23 07.75	81 37 56.65	257 00 22	Reddie 1	77 21 03	2235.3	2444.5	1.39
			209 44 51	Broward	29 45 06	1554.9	1700.4	0.97
Reddie 2	30 22 42.99	81 36 59.89	116 42 29	Sandfly Point	296 42 00	1695.9	1854.5	1.05
			160 36 44	Broward	340 36 30	2239.0	2448.5	1.39
Point Suarez	30 21 53.68	81 37 12.05	152 25 49	Sandfly Point	332 25 26	2572.4	2813.1	1.60
			192 03 45	Reddie 2	12 03 51	1552.4	1697.6	0.96
Bigelow 1	30 21 33.53	81 36 22.81	115 16 14	Point Suarez	295 15 49	1453.5	1589.5	0.90
			155 09 47	Reddie 2	335 09 29	2356.5	2577.0	1.46

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VI.—St. John's River.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Baldwin	30 20 57.60	81 37 20.18	187 10 07	Point Suarez	7 10 11	1740.5	1903.3	1.08
			234 09 41	Bigelow 1	54 10 10	1889.7	2066.5	1.17
Bigelow 2	30 20 39.40	81 36 19.86	109 11 16	Baldwin	289 10 46	1705.5	1865.1	1.06
			177 17 55	Bigelow 1	357 17 54	1668.6	1824.7	1.04
Buckman	30 18 54.84	81 36 53.84	169 27 27	Baldwin	349 27 14	3844.9	4204.7	2.39
			195 44 16	Bigelow 2	15 44 33	3345.0	3658.0	2.08
North Base	30 20 24.51	81 37 28.33	192 04 41	Baldwin	12 04 45	1041.7	1139.2	0.65
			255 55 43	Bigelow 2	75 56 17	1885.4	2061.8	1.17
Sammis	30 19 45.91	81 36 25.75	25 30 36	Buckman	205 30 22	1742.8	1905.9	1.08
			125 25 23	North Base	305 24 51	2051.4	2243.3	1.27
South Base	30 19 36.14	81 37 37.93	189 45 08	North Base	9 45 13	1511.7	1653.2	0.94
			317 11 17	Buckman	137 11 39	1733.3	1895.5	1.08
Hudnall	30 18 41.27	81 38 07.54	205 05 10	South Base	25 05 25	1865.5	2040.0	1.16
			258 00 46	Buckman	78 01 23	2012.9	2201.3	1.25
Alsop	30 19 23.80	81 38 40.33	287 24 06	Buckman	107 25 00	2981.0	3259.9	1.85
			326 14 03	Hudnall	146 14 20	1575.5	1722.9	0.98
Hendrick	30 18 46.49	81 39 16.43	220 00 21	Alsop	40 00 39	1499.7	1640.0	0.93
			274 59 54	Hudnall	95 00 29	1846.9	2019.7	1.15
Judson	30 19 37.60	81 39 28.58	288 14 45	Alsop	108 15 09	1357.6	1484.6	0.84
			348 19 47	Hendrick	168 19 53	1607.0	1757.3	1.00
Sollee's Mill	30 18 57.02	81 38 37.45	174 41 09	Alsop	354 40 54	828.2	905.7	0.51
			271 22 54	Buckman	91 23 46	2768.6	3027.6	1.72
McRory's Mill	30 19 16.84	81 38 20.20	286 22 11	Buckman	106 22 55	2404.5	2629.5	1.49
			58 07 44	Hendrick	238 07 16	1786.7	1953.9	1.11
Hendrick's Point	30 19 08.67	81 39 23.95	248 12 24	Alsop	68 12 46	1245.9	1362.4	0.77
			172 04 58	Judson	352 04 56	899.5	983.7	0.56
Winter's Point	30 18 38.82	81 40 25.65	220 05 32	Judson	40 06 01	2366.2	2587.6	1.47
			262 42 51	Hendrick	82 43 26	1864.2	2038.6	1.16
McIntosh's Chimney	30 19 26.23	81 39 57.25	281 08 41	Buckman	101 10 14	4993.2	5460.4	3.10
			301 17 17	Hendrick's Point	121 17 34	1041.1	1138.5	0.65
Holmes & Reed's Mill	30 19 32.35	81 39 42.51	284 22 02	Buckman	104 23 27	4650.7	5085.9	2.89
			325 47 26	Hendrick's Point	145 47 35	882.0	964.5	0.55
Fairbanks' Mill	30 19 28.07	81 39 49.64	242 25 06	Judson	62 25 17	643.3	703.5	0.40
			311 02 28	Hendrick's Point	131 02 41	909.7	994.8	0.56
Dr. Dell's Flagstaff	30 19 31.95	81 39 08.06	30 38 26	Hendrick's Point	210 38 18	833.1	911.1	0.52
			107 37 07	Judson	287 36 57	575.5	629.3	0.36
Dr. Dell's House, East chimney	30 19 29.99	81 38 59.97	18 10 15	Hendrick	198 10 07	1409.4	1541.3	0.87
			55 27 50	Winter's Point	235 27 07	2778.3	3038.3	1.73
Buffington House, spire of cupola	30 19 37.46	81 39 06.78	9 19 43	Hendrick	189 19 38	1590.1	1738.9	0.99
			90 28 00	Judson	270 27 49	582.7	637.3	0.36
Jaksonville Methodist Church, cupola.	30 19 43.38	81 39 02.73	11 47 22	Hendrick	191 47 15	1789.2	1956.7	1.11
			75 34 09	Judson	255 33 56	713.0	779.7	0.44
Jacksonville Episcopal Church, steeple.	30 19 42.71	81 38 59.95	14 15 22	Hendrick	194 15 14	1785.9	1953.0	1.11
			78 23 25	Judson	258 23 11	780.7	853.8	0.49
De Cotte's Mill, chimney	30 19 26.64	81 38 48.22	31 21 27	Hendrick	211 21 12	1447.5	1582.9	0.90
			107 23 29	Judson	287 23 09	1129.8	1235.5	0.70
Butler's Old Mill	30 19 27.35	81 38 40.70	37 11 29	Hendrick	217 11 11	1578.9	1726.6	0.98
			63 32 55	Hendrick's Point	243 32 33	1290.5	1411.2	0.80
Taylor's Mill, chimney	30 19 10.59	81 38 02.49	284 48 27	Buckman	104 49 02	1896.8	2074.2	1.18
			8 30 53	Hudnall	188 30 50	912.2	997.5	0.57
Finnegan's Mill, chimney	30 19 19.72	81 38 28.32	108 53 46	Judson	288 53 16	1701.6	1860.9	1.06
			286 52 36	Buckman	106 53 24	2637.6	2884.4	1.64
Henry Holmes' House, chimney	30 18 35.09	81 37 49.94	126 09 40	Judson	306 08 50	3263.8	3569.2	2.03
			225 52 04	Sammis	45 52 46	3132.6	3425.7	1.95
Buckman's Old Mill	30 18 44.25	81 37 10.97	155 44 27	South Base	335 44 13	1752.5	1916.5	1.09
			171 27 10	North Base	351 27 01	3122.0	3414.1	1.94
Empire Mill	30 19 01.67	81 36 44.71	126 43 57	South Base	306 43 30	1774.0	1940.0	1.10
			200 23 39	Sammis	20 23 49	1452.9	1588.9	0.90
Ferris House, East chimney	30 18 38.08	81 37 44.63	123 26 06	Judson	303 25 14	3327.6	3638.9	2.07
			185 42 16	South Base	5 42 19	1796.7	1964.8	1.12

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VI.—St. John's River.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Houston's House, chimney	30 20 00.14	81 37 30.92	237 29 23	Bigelow 2	57 29 59	2250.0	2460.5	1.40
			284 07 57	Sammis	104 08 30	1795.0	1963.0	1.12
White flag 1, right bank	30 21 47.25	81 36 32.77	39 37 51	Baldwin	219 37 27	1984.8	2170.5	1.24
			100 42 06	Point Suarez	280 41 46	1067.2	1167.1	0.66
White flag 2, right bank	30 20 09.70	81 36 28.03	16 38 40	Buckman	196 38 27	2405.8	2630.9	1.50
			61 02 06	South Base	241 01 31	2133.7	2333.3	1.33
White flag 1, left bank	30 21 17.76	81 37 17.67	307 25 00	Bigelow 2	127 25 29	1943.7	2125.5	1.21
			6 09 37	Baldwin	186 09 36	624.3	682.7	0.39
White flag 2, left bank	30 20 32.50	81 37 15.54	317 10 30	Sammis	137 10 55	1956.5	2139.6	1.22
			261 51 09	Bigelow 2	81 51 37	1502.2	1642.7	0.93
White flag 3, right bank	30 19 29.09	81 36 27.88	33 18 47	Buckman	213 18 34	1262.1	1380.2	0.78
			96 36 58	South Base	276 36 23	1883.4	2059.6	1.17
Dead Tree 1	30 21 02.47	81 36 14.21	59 27 11	North Base	239 26 34	2298.6	2513.7	1.43
			85 08 39	Baldwin	265 08 06	1767.8	1933.2	1.10
Dead Tree 2	30 19 54.66	81 36 28.56	20 07 37	Buckman	200 07 24	1961.8	2145.4	1.22
			119 56 02	North Base	299 55 32	1842.5	2014.9	1.15
Robert Bigelow's House, chimney	30 20 31.88	81 36 17.74	51 17 57	South Base	231 17 17	2744.8	3001.6	1.71
			115 24 47	Baldwin	295 24 16	1846.1	2018.9	1.15
House on Baxter's place	30 22 09.11	81 36 24.27	69 34 50	Point Suarez	249 34 26	1361.1	1488.4	0.85
			137 39 15	Reddie 2	317 38 57	1411.7	1543.8	0.88
Daniel's Mill, chimney	30 22 06.76	81 37 30.80	159 48 48	Sandfly Point	339 48 35	2000.6	2187.8	1.24
			216 28 48	Reddie 2	36 29 04	1387.4	1517.2	0.86
Shanty	30 22 59.80	81 37 01.23	8 04 24	Point Suarez	188 04 19	2056.2	2248.6	1.28
			99 23 48	Sandfly Point	279 23 20	1499.6	1639.9	0.93
White flag at mouth of Trout Creek	30 23 40.62	81 37 52.17	321 48 30	Reddie 2	141 48 56	2257.3	2468.5	1.40
			6 44 22	Sandfly Point	186 44 20	1019.0	1114.3	0.63
Drummond's Point	30 24 42.26	81 36 01.17	296 47 26	Balsan	116 48 32	3891.6	4255.8	2.42
			250 44 23	Cedar Creek	70 44 44	1161.3	1269.9	0.72
Barked Pine on North shore	30 24 13.13	81 36 51.96	343 23 29	Reddie 1	163 23 38	1589.7	1738.4	0.99
			40 37 39	Sandfly Point	220 37 06	2652.3	2900.5	1.65
Black flag in tree	30 24 16.91	81 36 39.09	356 08 07	Reddie 1	176 08 09	1643.4	1797.2	1.02
			59 02 12	Broward	239 01 47	1514.6	1656.3	0.94
Barked Pine on South shore	30 22 46.67	81 35 20.74	232 59 45	Balsan	53 00 30	2999.3	3280.0	1.86
			258 37 22	Newcastle	78 37 33	571.0	624.4	0.35
McNeil's House, chimney	30 23 19.82	81 36 18.40	208 03 00	Cedar Creek	28 03 30	3310.5	3620.2	2.06
			293 23 03	Newcastle	113 23 43	2287.0	2500.9	1.42
House on Newcastle Plantation	30 22 25.14	81 34 54.25	171 29 19	Cedar Creek	351 29 06	4656.5	5092.2	2.89
			214 22 28	Balsan	34 23 00	2989.8	3269.5	1.86
Tall Dead Tree	30 23 13.48	81 36 26.22	209 31 48	Cedar Creek	29 32 21	3582.5	3917.7	2.23
			287 09 19	Newcastle	107 10 03	2415.5	2641.5	1.50
Black flag on Crab Island	30 23 27.65	81 35 01.22	100 41 23	Broward	280 40 09	3980.0	4352.4	2.47
			253 50 49	Balsan	73 51 24	1951.1	2133.7	1.21
Black flag at mouth of Dunn's Creek.	30 25 00.75	81 34 51.50	42 43 26	Reddie 1	222 42 34	4069.2	4350.0	2.53
			72 58 23	Drummond's Point	252 57 48	1944.0	2125.9	1.21
White flag at mouth of Dunn's Creek.	30 24 33.63	81 34 36.19	55 48 09	Reddie 1	235 47 09	3832.5	4191.1	2.38
			96 41 32	Drummond's Point	276 40 49	2283.2	2496.8	1.42
Post Office at Yellow Bluff	30 24 08.88	81 32 47.84	298 25 48	Palmetto	118 26 40	3139.2	3433.0	1.95
			343 38 48	Bird Island	163 39 08	3654.0	3995.9	2.27
White and black flag	30 22 32.36	81 34 20.64	233 27 59	Dame's Point	53 28 32	2196.3	2401.8	1.36
			160 06 16	Cedar Creek	340 05 46	4661.0	5097.1	2.90
Black flag on North shore	30 24 09.43	81 34 16.86	129 34 17	Cedar Creek	309 33 45	2188.6	2393.4	1.36
			25 11 31	Newcastle	205 11 09	2691.4	2943.2	1.67
White flag on South shore	30 23 06 16	81 35 53.57	249 46 38	Balsan	69 47 40	3468.3	3792.8	2.15
			288 44 24	Newcastle	108 44 51	1516.4	1658.3	0.94
White flag	30 23 06.72	81 27 44.05	257 46 50	Sand Hill 3	77 47 54	3467.9	3792.3	2.15
			136 00 39	Pelot	315 59 26	5553.5	6073.1	3.45
Cross on Marsh Island	30 22 53.58	81 32 55.14	141 37 24	Dame's Point	321 37 14	834.2	912.3	0.52
			314 07 57	Bird Island	134 08 20	1705.4	1865.0	1.06
Second cross on Marsh Island	30 22 52.04	81 32 54.86	143 09 47	Dame's Point	323 09 37	876.6	958.6	0.54
			313 08 30	Bird Island	133 08 53	1667.0	1822.9	1.04

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VI.—St. John's River.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Black and white flag	30 23 51.86	81 29 25.85	265 44 13	Sister	85 45 20	3550.2	3882.4	2.21
			69 45 09	Palmetto	249 44 19	2803.9	3066.3	1.74
General Hopkins' House	30 23 12.55	81 29 40.23	138 46 51	Brown's Island	318 45 46	5223.8	5712.6	3.25
			197 35 11	Black and white flag	17 35 18	1296.6	1417.9	0.81
Dr. Balsan's House, North chimney	30 23 18.80	81 33 13.21	269 12 03	Palmetto	89 13 08	3438.1	3759.8	2.14
			15 30 12	Mitchell	195 30 02	2061.1	2253.9	1.28
White flag on Marsh Island	30 24 26.34	81 31 42.23	333 35 08	Palmetto	153 35 27	2269.4	2481.8	1.41
			10 08 05	Bird Island	190 07 51	4108.2	4492.6	2.55
Quarantine flag	30 23 11.81	81 33 25.22	7 24 56	Mitchell	187 24 52	1785.8	1952.9	1.11
			75 19 17	Newcastle	255 18 29	2609.4	2853.6	1.62
Black flag on Marsh Island	30 23 47.36	81 32 01.89	3 58 43	Bird Island	183 58 39	2850.6	3117.4	1.77
			186 45 05	Brown's Island	6 45 11	2876.4	3145.5	1.79
White flag in tree in Mill Cove	30 20 58.78	81 31 41.79	149 25 00	Dame's Point	329 24 13	4866.0	5321.3	3.02
			162 37 28	Bird Island	342 37 14	2459.5	2689.7	1.53
White flag on marsh in Mill Cove	30 21 26.21	81 32 02.34	150 02 49	Dame's Point	330 02 12	3859.7	4220.8	2.40
			203 45 10	Palmetto	23 45 39	3839.1	4198.4	2.38
White and black flag on Marsh Island.	30 22 51.78	81 32 01.35	64 56 57	Mitchell	244 56 10	2725.6	2980.6	1.69
			10 37 43	Bird Island	190 37 39	1151.9	1259.7	0.72
Flag in oak near Mill Cove	30 22 24.95	81 30 50.76	85 41 46	Mitchell	265 40 24	4365.7	4774.2	2.71
			46 35 49	White flag on marsh in Mill Cove.	226 35 13	2631.3	2877.5	1.64
One-story white house, North end	30 21 51.80	81 32 46.26	163 32 43	Dame's Point	343 32 29	2665.5	2914.9	1.66
			234 04 42	Bird Island	54 05 01	1218.3	1332.3	0.76
St. John's River to St. Augustine.								
St. Augustine Base, North end	29 54 27.84	81 20 32.24	....		....	....	....	.....
St. Augustine Base, South end	29 52 05.82	81 19 53.37	166 35 25	North Base	346 35 06	4495.2	4915.8	2.79
St. Augustine Light-house	29 53 13.35	81 16 57.40	111 42 54	North Base	291 41 07	6202.7	6783.1	3.85
			66 14 50	South Base	246 13 22	5159.2	5642.0	3.20
Allen	29 55 53.14	81 17 35.71	348 12 08	Light-house	168 12 27	5025.6	5495.8	3.12
			60 59 47	North Base	240 58 19	5414.2	5920.8	3.36
Presbyterian Church	29 53 19.60	81 18 29.65	44 41 23	South Base	224 40 41	3194.8	3493.7	1.99
			197 00 43	Allen	17 01 10	4943.6	5406.1	3.07
Canova	29 51 05.82	81 18 32.66	181 07 22	Presbyterian Church	1 07 23	4119.7	4505.2	2.56
			213 03 28	Light-house	33 04 15	4685.3	5123.7	2.91
Scrub	29 51 41.40	81 16 42.24	69 43 01	Canova	249 42 06	3159.4	3455.0	1.96
			171 49 24	Light-house	351 49 16	2860.0	3127.6	1.78
North Beach	29 54 16.41	81 17 24.27	339 38 19	Light-house	159 38 32	2071.0	2264.8	1.29
			174 07 20	Allen	354 07 14	2994.1	3274.3	1.86
Fort Marion, northeast tower	29 53 53.25	81 18 27.16	200 29 32	Allen	20 29 58	3940.7	4309.5	2.45
			325 15 11	Scrub	145 16 03	4940.5	5402.7	3.07
Episcopal Church, spire	29 53 31.26	81 18 31.82	282 16 30	Light-house	102 17 17	2592.3	2834.8	1.61
			0 17 07	Canova	180 17 07	4478.4	4897.5	2.78
South end of barracks, lightning rod.	29 53 15.01	81 18 22.44	316 58 41	Scrub	136 59 31	3941.8	4310.7	2.45
			271 16 02	Light-house	91 16 45	2282.1	2495.6	1.42
House on Fisher's Island, chimney	29 51 48.05	81 17 53.83	38 42 34	Canova	218 42 15	1666.4	1822.3	1.04
			276 04 28	Scrub	96 05 04	1932.1	2112.9	1.20
Tom	29 50 32.77	81 17 00.57	193 07 01	Scrub	13 07 10	2170.0	2373.0	1.35
			112 23 27	Canova	292 22 41	2673.1	2923.2	1.66
Day	29 52 04.37	81 15 38.87	135 13 43	Light-house	315 13 04	2991.6	3271.6	1.86
			116 49 32	Presbyterian Church	296 48 07	5134.1	5614.5	3.19
Anastasia 2	29 49 19.37	81 15 56.44	164 18 09	Scrub	344 17 46	4542.2	4967.2	2.82
			128 01 11	Canova	307 59 53	5321.9	5819.9	3.31
Manly	29 49 26.47	81 17 46.78	274 12 24	Anastasia 2	94 13 19	2970.2	3248.1	1.85
			202 37 53	Scrub	22 38 25	4501.2	4922.4	2.80
Government	29 47 16.57	81 16 37.10	154 56 16	Manly	334 55 41	4415.1	4828.3	2.74
			196 06 26	Anastasia 2	16 06 46	3935.6	4303.8	2.45
Anastasia 3	29 48 04.89	81 15 36.28	166 43 27	Anastasia 2	346 43 17	2356.0	2576.5	1.46
			47 40 33	Government	227 40 03	2209.5	2416.3	1.37
Cocked Hat	29 57 10.98	81 18 04.55	342 07 01	Allen	162 07 15	2518.4	2754.1	1.56
			38 16 04	North Base	218 14 50	6396.6	6995.1	3.97
Baya	29 55 42.11	81 19 12.31	262 31 37	Allen	82 32 25	2612.8	2857.3	1.62
			213 34 51	Cocked Hat	33 35 25	3284.7	3592.0	2.04

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VI—St. John's River to St. Augustine.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Sanchez	29 56 56.88	81 19 29.76	329 17 21	Light-house	149 18 37	8003.9	8752.9	4.97
			302 40 52	Allen	122 41 49	3633.6	3973.6	2.26
Casacola	29 58 11.28	81 20 07.34	336 15 20	Sanchez	156 15 39	2502.8	2737.0	1.56
			299 24 51	Cocked Hat	119 25 52	3779.5	4133.2	2.35
Harrison	29 58 54.92	81 18 32.91	346 38 15	Cocked Hat	166 38 29	3289.1	3596.9	2.04
			62 03 08	Casacola	242 02 21	2866.0	3134.2	1.78
Mauran	30 01 27.59	81 21 25.35	340 54 51	Casacola	160 55 30	6395.6	6994.0	3.97
			315 28 38	Harrison	135 30 04	6591.8	7208.6	4.10
Big Sand Hill	30 01 33.48	81 19 25.99	343 44 56	Harrison	163 45 23	5084.8	5560.5	3.16
			86 46 05	Mauran	266 45 05	3203.0	3502.7	1.99
Deep Creek	30 03 02.36	81 22 18.14	334 08 17	Mauran	154 08 43	3242.5	3545.9	2.01
			300 40 34	Big Sand Hill	120 42 00	5362.3	5864.0	3.33
Hernandez	30 03 19.35	81 19 37.57	354 33 50	Big Sand Hill	174 33 56	3274.4	3580.8	2.03
			83 04 42	Deep Creek	263 03 22	4332.4	4737.8	2.69
Jenks	30 06 13.09	81 20 19.03	28 30 55	Deep Creek	208 29 55	6682.7	7308.1	4.15
			348 16 21	Hernandez	168 16 42	5463.5	5974.7	3.39
Smith	30 05 33.64	81 22 19.16	313 41 13	Hernandez	133 42 34	5985.3	6545.4	3.72
			249 18 18	Jenks	69 19 18	3437.9	3759.5	2.14
Travis	30 07 16.26	81 22 48.88	345 51 47	Smith	165 52 02	3258.0	3562.8	2.02
			295 51 22	Jenks	115 52 37	4458.0	4875.1	2.77
Mickler	30 08 25.22	81 20 51.94	347 46 45	Jenks	167 47 02	4162.5	4551.9	2.59
			55 51 18	Travis	235 50 19	3782.0	4135.9	2.35
Diego	30 08 32.92	81 22 25.35	14 56 32	Travis	194 56 20	2442.9	2671.5	1.52
			275 24 39	Mickler	95 25 26	2510.9	2745.9	1.56
Persimmon	30 10 59.03	81 21 28.76	348 15 02	Mickler	168 15 21	4837.4	5290.0	3.01
			18 36 23	Diego	198 35 54	4746.8	5190.9	2.95
Masters	30 10 33.70	81 23 11.99	341 26 29	Diego	161 27 12	3922.7	4289.8	2.44
			254 13 11	Persimmon	74 14 03	2869.8	3138.3	1.78
Blake	30 12 31.91	81 23 30.57	352 13 34	Masters	172 13 43	3673.7	4017.4	2.28
			311 16 03	Persimmon	131 17 04	4335.1	4740.8	2.69
Point Solana	30 12 43.80	81 21 58.07	346 20 27	Persimmon	166 20 42	3317.0	3627.3	2.06
			81 39 15	Blake	261 38 28	2501.1	2735.1	1.55
Tam Smith	30 15 34.67	81 22 44.21	12 25 40	Blake	192 25 17	5762.1	6301.3	3.58
			346 48 05	Point Solana	166 48 28	5406.6	5912.5	3.36
Maill	30 14 38.19	81 24 53.13	306 56 43	Point Solana	126 58 11	5857.9	6406.0	3.64
			243 12 52	Tam Smith	63 13 57	3860.4	4221.6	2.40
Mulatto Jack	30 16 39.20	81 25 15.05	296 13 14	Tam Smith	116 14 30	4494.4	4914.9	2.79
			351 03 50	Maill	171 04 01	3771.4	4124.3	2.34
St. Isabelle	30 16 53.74	81 23 01.78	349 04 54	Tam Smith	169 05 03	2479.3	2711.3	1.54
			82 50 30	Mulatto Jack	262 49 23	3589.7	3925.6	2.23
Hopkins	30 18 23.86	81 24 53.05	313 00 56	St. Isabelle	133 01 52	4066.9	4447.4	2.53
			10 20 25	Mulatto Jack	190 20 14	3275.9	3582.4	2.04
Drumruck	30 18 38.40	81 23 23.47	349 48 09	St. Isabelle	169 48 20	3274.3	3580.7	2.03
			79 24 35	Hopkins	259 23 50	2434.8	2662.6	1.51
Sea	30 20 21.09	81 23 35.77	354 03 53	Drumruck	174 03 59	3179.2	3476.7	1.97
			92 29 35	Pine Island	272 28 27	3572.1	3906.3	2.22
Cooper's Landing	30 03 27.28	81 20 53.58	71 17 46	Deep Creek	251 17 04	2391.4	2615.1	1.49
			13 00 34	Mauran	193 00 18	3782.0	4135.9	2.35
Marsh	30 04 33.71	81 21 21.12	340 09 31	Cooper's Landing	160 09 45	2174.6	2378.0	1.35
			28 29 54	Deep Creek	208 29 25	3200.4	3499.8	1.99
Palmetto	30 04 42.56	81 22 19.94	315 03 22	Cooper's Landing	135 04 05	3274.6	3581.0	2.03
			279 48 39	Marsh	99 49 09	1598.2	1747.8	0.99
Cook	30 05 29.20	81 21 35.86	96 44 39	Smith	276 44 17	1167.2	1276.4	0.73
			346 59 43	Marsh	166 59 50	1753.4	1917.5	1.09
Tall Pine	30 07 03.48	81 21 56.49	349 13 25	Cook	169 13 35	2955.1	3231.6	1.84
			12 22 16	Smith	192 22 05	2831.7	3096.7	1.76
Squibob	30 08 54.29	81 20 58.76	74 09 07	Diego	254 08 24	2408.9	2634.3	1.50
			348 29 05	Mickler	168 29 08	913.5	998.9	0.57
Andrea	30 00 19.59	81 20 12.69	137 05 26	Mauran	317 04 50	2859.3	3126.9	1.78
			357 55 14	Casacola	177 55 17	3952.7	4322.6	2.46

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VI.—St. John's River to St. Augustine.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Hammock, flag	29 59 20.06	81 20 31.92	195 42 39	Andrea	15 42 49	1904.0	2082.2	1.18
			159 58 26	Mauran	339 58 00	4179.7	4570.8	2.60
Alvarez's House, chimney	29 58 10.72	81 20 13.41	263 49 56	Casacola	83 49 59	163.8	179.2	0.10
			243 11 11	Harrison	63 12 01	3018.6	3301.0	1.87
Cedar Hammock	30 02 42.59	81 21 16.87	110 21 08	Deep Creek	290 20 37	1750.4	1914.2	1.09
			5 37 06	Mauran	185 37 02	2320.4	2537.5	1.44
Florida Reef.								
LIGNUM VITÆ	24 53 58.06	80 42 17.87	....	....	....	....	....	......
TWIN KEYS	24 57 57.22	80 44 40.99	331 21 22	Lignum vitæ	151 22 23	8384.5	9169.0	5.21
Torry	24 59 13.91	80 40 19.48	18 52 04	Lignum vitæ	198 51 14	10269.1	11230.0	6.38
			72 10 56	Twin Keys	252 09 05	7705.2	8426.2	4.79
Upper Matacumba	24 55 22.51	80 37 59.75	70 16 34	Lignum vitæ	250 14 45	7693.2	8413.1	4.78
			112 56 39	Twin Keys	292 53 50	12221.4	13364.9	7.59
West	24 58 54.69	80 39 03.02	344 47 21	Upper Matacumba	164 47 48	6765.2	7398.2	4.20
			79 27 07	Twin Keys	259 24 45	9643.1	10545.4	5.99
Mark	24 57 12.17	80 35 59.02	117 09 41	Torry	297 07 51	8208.9	8977.0	5.10
			121 26 46	West	301 25 29	6048.0	6613.9	3.76
East	24 59 49.75	80 36 39.48	15 19 08	Upper Matacumba	195 18 34	8524.8	9322.4	5.30
			346 49 35	Mark	166 49 52	4979.1	5445.0	3.09
Middle Plantation	24 58 39.27	80 33 27.64	92 54 27	West	272 52 05	9416.8	10297.9	5.85
			111 57 53	East	291 56 32	5799.8	6342.5	3.60
Low	25 03 00.86	80 34 47.36	344 28 35	Middle Plantation	164 29 09	8352.9	9134.5	5.19
			28 07 54	East	208 07 07	6667.4	7291.3	4.14
Pigeon	25 03 21.20	80 30 49.34	56 28 57	East	236 26 29	11775.6	12877.4	7.32
			84 39 16	Low	264 37 35	6700.1	7327.0	4.16
Bank	24 59 11.83	80 36 10.34	282 22 19	Middle Plantation	102 23 28	4671.1	5108.2	2.90
			355 04 10	Mark	175 04 15	3695.1	4040.9	2.30
Tavernier Creek	25 00 44.55	80 32 42.41	63 56 20	Bank	243 54 52	6490.7	7098.1	4.03
			140 08 29	Low	320 07 36	5464.1	5975.4	3.40
Pie	25 06 38.14	80 32 09.81	33 25 27	Low	213 24 20	8007.6	8756.9	4.98
			339 32 27	Pigeon	159 33 01	6465.8	7070.8	4.02
Sever	25 06 30.21	80 29 23.03	22 30 39	Pigeon	202 30 03	6293.7	6882.5	3.91
			92 59 59	Pie	272 58 48	4674.0	5111.4	2.90
Moat	25 08 51.30	80 30 20.42	339 36 03	Sever	159 36 27	4630.3	5063.5	2.88
			36 42 21	Pie	216 41 35	5109.0	5587.0	3.17
Batti	25 09 34.25	80 27 46.50	25 27 56	Sever	205 27 15	6270.3	6857.0	3.90
			72 57 31	Moat	252 56 25	4506.5	4928.2	2.80
Hammer Point	25 01 48.83	80 30 56.94	184 17 03	Pigeon	4 17 06	2850.0	3116.7	1.77
			167 03 11	Pie	347 02 40	9132.4	9986.9	5.67
Bottle Point	25 04 19.06	80 33 24.01	44 07 06	Low	224 06 31	3350.7	3664.3	2.08
			205 53 52	Pie	25 54 23	4756.0	5201.1	2.96
Butternut	25 05 08.00	80 31 13.11	56 54 20	Low	236 52 49	7160.9	7831.0	4.45
			230 36 16	Sever	50 37 03	3985.5	4358.4	2.48
Road	25 04 22.73	80 28 01.02	68 07 51	Pigeon	248 06 40	5079.0	5554.2	3.16
			149 34 41	Sever	329 34 06	4548.0	4973.5	2.83
Whaleback	25 07 47.13	80 29 07.51	214 28 55	Batti	34 29 29	3998.1	4372.2	2.48
			133 59 32	Moat	313 59 01	2842.3	3108.2	1.77
Tony	25 07 51.78	80 27 45.58	112 53 10	Moat	292 52 04	4709.5	5150.2	2.93
			47 22 32	Sever	227 21 50	3705.1	4051.8	2.30
Bruin	25 06 12.66	80 26 16.54	95 54 27	Sever	275 53 08	5253.1	5744.6	3.26
			40 50 33	Road	220 49 49	4469.9	4888.1	2.78
Greentop Tree	25 05 07.21	80 27 06.97	167 51 48	Tony	347 51 31	5178.2	5662.8	3.22
			141 47 23	Moat	321 46 01	8774.3	9595.3	5.45
Deep Point	25 06 59.88	80 37 58.57	323 51 39	Low Key	143 53 00	9103.2	9955.0	5.66
			273 53 37	Pie Key	93 56 05	9797.3	10714.0	6.09
Spit	25 09 40.71	80 33 03.21	59 07 45	Deep Point	239 05 39	9639.3	10541.3	5.99
			345 02 35	Pie Key	165 02 58	5814.3	6358.3	3.61
East Key	24 59 49.75	80 36 39.48	210 59 49	Pie Key	31 01 43	14659.2	16030.9	9.11
			170 27 16	Deep Point	350 26 43	13418.4	14674.0	8.34

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VI.—Florida Reef.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bob Key, flag in tree	25 06 16.38	80 35 12.54	106 03 45	Deep Point	286 02 34	4839.9	5292.7	3.01
			262 32 35	Pie Key	82 33 53	5167.2	5650.7	3.21
Park Key, flag in tree	25 07 27.01	80 33 57.19	200 09 41	Spit	20 10 04	4382.9	4793.0	2.72
			246 50 53	Moat Key	66 52 25	6596.8	7214.0	4.10
Lake Key, flag in tree	25 08 19.36	80 33 38.51	71 27 30	Deep Point	251 25 40	7683.6	8402.5	4.77
			201 33 03	Spit	21 33 18	2691.2	2943.0	1.67
Eagle Key, flag in tree	25 09 49.76	80 35 53.64	313 12 33	Pie Key	133 14 08	8609.2	9414.8	5.35
			273 19 45	Spit	93 20 58	4780.5	5227.8	2.97
Deer Key, flag in tree	25 11 00.49	80 32 35.93	354 47 17	Pie Key	174 47 28	8105.1	8863.5	5.04
			17 16 39	Spit	197 16 27	2570.8	2811.3	1.60
Mainland 1, flag in tree	25 12 42.14	80 34 47.94	332 16 58	Spit	152 17 43	6305.4	6895.4	3.92
			338 23 54	Pie Key	158 25 01	12044.9	13171.9	7.48
Mainland 2, flag in tree	25 11 08.95	80 39 19.18	284 26 17	Spit	104 28 57	10871.1	11888.3	6.75
			304 41 05	Pie Key	124 44 07	14633.2	16002.4	9.09
St. Joseph's Bay and Clear Water Harbor.								
South Anclote	28 10 19.40	82 51 23.65						
Piny Point	28 10 00.75	82 48 46.57	97 38 24	South Anclote	277 37 10	4322.7	4727.2	2.69
Hog Island North	28 05 19.93	82 50 27.19	170 30 58	South Anclote	350 30 31	9345.7	10220.1	5.81
			197 36 53	Piny Point	17 37 40	9069.5	9918.1	5.63
Indian Bluff	28 06 36.51	82 47 47.88	139 22 58	South Anclote	319 21 16	9040.2	9886.1	5.62
			165 42 48	Piny Point	345 42 20	6487.6	7094.6	4.03
Bayonet Point	28 03 19.60	82 48 09.98	134 41 07	Hog Island North	314 40 02	5267.9	5760.8	3.27
			185 40 58	Indian Bluff	5 41 09	6091.0	6660.9	3.78
St. Joseph's Flat	28 02 10.43	82 49 38.75	167 13 34	Hog Island North	347 13 11	5981.1	6540.7	3.72
			228 41 58	Bayonet Point	48 42 40	3226.2	3528.1	2.00
Orange Grove	28 01 48.90	82 48 19.52	151 47 14	Hog Island North	331 46 14	7372.0	8061.8	4.58
			185 19 43	Bayonet Point	5 19 47	2803.9	3066.3	1.74
Elbow Key	28 00 43.41	82 49 21.65	170 06 44	St. Joseph's Flat	350 06 36	2718.8	2973.2	1.69
			220 05 30	Orange Grove	40 05 59	2634.9	2881.5	1.64
Longreach	27 59 31.98	82 48 44.67	155 19 28	Elbow Key	335 19 11	2419.8	2646.2	1.50
			189 15 25	Orange Grove	9 15 37	4270.1	4669.6	2.65
Blind Key	27 59 12.12	82 49 47.36	194 02 06	Elbow Key	14 02 18	2896.3	3167.3	1.80
			250 21 54	Longreach	70 22 23	1818.7	1988.9	1.13
Clearwater Bluff	27 57 55.60	82 49 07.68	155 17 08	Blind Key	335 16 50	2593.0	2835.6	1.61
			191 58 03	Longreach	11 58 14	3032.4	3316.1	1.88
North Base	27 58 10.32	82 50 47.31	220 43 34	Blind Key	40 44 02	2510.5	2745.4	1.56
			279 26 31	Clearwater Bluff	99 27 18	2760.0	3018.2	1.72
McKay's Point	27 55 52.08	82 50 14.18	205 32 50	Clearwater Bluff	25 33 21	4213.7	4607.9	2.62
			167 59 09	North Base	347 58 54	4350.0	4757.0	2.70
South Base	27 56 46.74	82 51 13.70	315 56 59	McKay's Point	135 57 27	2340.4	2559.3	1.45
			238 23 10	Clearwater Bluff	58 24 09	4044.1	4422.5	2.51
Dead Tree	28 10 45.25	82 49 10.18	138 18 56	North Anclote	318 17 56	5248.5	5739.6	3.26
			77 40 47	South Anclote	257 39 44	3726.2	4074.9	2.32
Stumpy Point	28 12 42.04	82 47 48.50	53 12 30	South Anclote	233 10 48	7328.3	8014.0	4.55
			35 12 47	Tiger Point	215 12 19	2808.8	3071.6	1.75
Middle Anclote	28 11 38.53	82 51 25.23	358 58 46	South Anclote	178 58 47	2436.1	2664.1	1.51
			184 48 17	North Anclote	4 48 20	2287.5	2501.5	1.42
Round Palmetto	28 10 36.35	82 51 39.41	251 23 39	Tiger Point	71 25 00	4935.3	5397.1	3.07
			283 04 24	Piny Point	103 05 46	4840.0	5292.9	3.01
East Point	28 10 24.72	82 49 07.62	87 29 03	South Anclote	267 27 59	3713.8	4061.3	2.31
			141 58 00	North Anclote	321 56 58	5778.7	6319.4	3.59
Round Point	28 08 39.64	82 48 06.59	31 58 52	Hog Island North	211 57 46	7246.3	7924.3	4.50
			119 45 00	South Anclote	299 43 27	6190.8	6770.1	3.85
Stony Point	28 07 17.18	82 47 46.25	50 36 06	Hog Island North	230 34 50	5685.0	6216.9	3.53
			133 24 53	South Anclote	313 23 10	8163.0	8926.8	5.07
Sea View	28 05 15.48	82 47 53.06	7 22 55	Bayonet Point	187 22 47	3596.6	3933.1	2.23
			91 52 35	Hog Island North	271 51 22	4209.6	4603.5	2.62

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VI.—St. Joseph's Bay and Clear Water Harbor.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
North Bend	28 04 10.34	82 47 59.68	36 14 35	St Joseph's Flat	216 13 48	4576.1	5004.3	2.84
			118 01 09	Hog Island North	297 59 59	4561.1	4987.9	2.83
Umbrella Pine	28 03 01.58	82 50 07.39	260 10 46	Bayonet Point	80 11 41	3253.6	3558.0	2.02
			307 12 29	Orange Grove	127 13 20	3699.2	4045.4	2.30
Green Top	28 02 25.81	82 48 11.83	10 27 56	Orange Grove	190 27 52	1155.5	1263.6	0.72
			78 43 24	St. Joseph's Flat	258 42 43	2420.3	2646.7	1.50

Section VII.—South of Cedar Keys to St. Joseph's Bay.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
CRYSTAL REEF	28 54 35.98	82 45 45.97						
BIRD KEY	28 48 53.12	82 46 06.06	182 57 01	Crystal Reef	2 57 11	10568.8	11557.7	6.57
Ragged Island	28 49 01.85	82 42 56.40	155 56 18	Crystal Reef	335 54 56	11265.6	12319.6	7.00
			87 01 06	Bird Key	266 59 35	5148.8	5630.5	3.20
Homosassa Point	28 46 34.07	82 45 19.30	220 24 53	Ragged Island	40 26 02	5975.9	6535.0	3.71
			163 30 17	Bird Key	343 29 54	4464.1	4881.8	2.77
Tucker's Island	28 46 29.47	82 42 45.07	176 15 13	Ragged Island	356 15 08	4701.0	5140.9	2.92
			91 57 01	Homosassa Point	271 55 47	4185.5	4577.1	2.60
Chassahowitzka Point	28 43 12.78	82 44 07.60	162 34 34	Homosassa Point	342 33 59	6494.8	7102.5	4.03
			200 17 11	Tucker's Island	20 17 51	6455.6	7059.6	4.01
Rocky Ridge	28 43 28.12	82 41 29.97	83 42 37	Chassahowitzka Point	263 41 21	4303.3	4705.9	2.67
			159 57 19	Tucker's Island	339 56 43	5942.9	6499.0	3.69
Little Rock	28 39 52.97	82 43 09.50	165 37 30	Chassahowitzka Point	345 37 02	6349.8	6943.9	3.94
			202 11 04	Rocky Ridge	22 11 52	7152.9	7822.2	4.44
Herring Bluff	28 39 53.99	82 40 17.19	163 19 24	Rocky Ridge	343 18 49	6881.1	7525.0	4.28
			89 37 30	Little Rock	269 36 07	4678.3	5116.1	2.91
Raccoon Point	28 36 37.21	82 40 38.69	145 48 24	Little Rock	325 47 12	7286.5	7968.3	4.53
			185 29 57	Herring's Bluff	5 30 07	6085.9	6655.3	3.78
High Pole	28 50 51.83	82 45 05.87	313 57 36	Ragged Island	133 58 38	4876.2	5332.5	3.03
			24 03 49	Bird Key	204 03 20	4002.0	4376.5	2.49
High Palmetto	28 50 10.91	82 43 29.20	337 17 53	Ragged Island	157 18 09	2304.2	2519.8	1.43
			60 37 24	Bird Key	240 36 08	4880.1	5336.7	3.03
St. Martin 1	28 48 48.76	82 49 07.57	268 25 32	Bird Key	88 27 00	4923.1	5383.8	3.06
			303 47 59	Homosassa Point	123 49 49	7449.9	8147.0	4.63
St. Martin 2	28 43 27.21	82 47 14.37	208 28 38	Homosassa Point	28 29 33	6544.6	7156.9	4.07
			274 59 54	Chassahowitzka Point	95 01 24	5087.6	5563.6	3.16
Hawk's Nest	28 48 08.62	82 45 09.92	131 59 34	Bird Key	311 59 07	2047.8	2239.4	1.27
			245 38 02	Ragged Island	65 39 06	3973.8	4345.7	2.47
Signal A	28 47 58.20	82 44 54.27	238 28 46	Ragged Island	58 29 43	3748.8	4099.5	2.33
			307 55 49	Tucker's Island	127 56 51	4442.7	4858.5	2.76
Signal B	28 47 33.81	82 44 19.42	219 42 17	Ragged Island	39 42 57	3523.1	3852.8	2.19
			307 44 16	Tucker's Island	127 45 01	3235.7	3538.4	2.01
Signal C	28 47 23.14	82 42 43.08	173 13 24	Ragged Island	353 13 18	3060.3	3346.6	1.90
			70 23 23	Homosassa Point	250 22 08	4497.9	4918.7	2.79
Signal D	28 48 12.36	82 42 33.50	157 49 54	Ragged Island	337 49 43	1645.2	1799.2	1.02
			9 43 34	Signal C	189 43 29	1537.4	1681.3	0.96
Signal E	28 45 00.41	82 42 44.48	179 40 00	Tucker's Island	359 40 00	2741.5	2998.0	1.70
			124 29 03	Homosassa Point	304 27 49	5094.0	5570.7	3.16
Signal F	28 44 10.18	82 42 51.68	182 23 49	Tucker's Island	2 23 52	4291.3	4692.8	2.67
			137 53 42	Homosassa Point	317 52 31	5971.6	6530.4	3.71
Small Palmetto	28 46 10.38	82 42 31.60	148 08 37	Tucker's Island	328 08 31	692.1	756.9	0.43
			99 07 25	Homosassa Point	279 06 04	4606.6	5037.6	2.86
Barrel Stake	28 45 31.76	82 44 11.84	136 21 25	Homosassa Point	316 20 53	2651.2	2899.3	1.65
			197 32 53	Ragged Island	17 33 29	6783.4	7418.1	4.21
Pigman's Reef	28 40 00.60	82 42 27.10	155 15 11	Chassahowitzka Point	335 14 23	6514.3	7123.8	4.05
			193 38 28	Rocky Ridge	13 38 55	6573.4	7188.4	4.08
Tilghman's Point	28 41 09.93	82 40 34.07	160 22 42	Rocky Ridge	310 22 15	4516.3	4938.9	2.81
			55 11 24	Pigman's Reef	235 10 30	3737.4	4087.1	2.32

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VII.—South of Cedar Keys to St. Joseph's Bay.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Shell Island	28 41 42.44	82 39 17.39	132 07 35	Rocky Ridge	312 06 31	4850.5	5304.3	3.01
			58 40 59	Pigman's Reef	238 39 28	6029.1	6593.3	3.75
Crawl Key	28 38 12.72	82 41 36.21	157 24 35	Pigman's Reef	337 24 11	3597.7	3934.3	2.24
			214 31 31	Herring's Bluff	34 32 09	3784.4	4138.5	2.35
High Palmetto	28 38 08.64	82 40 32.86	94 10 28	Crawl Key	274 09 58	1725.0	1886.4	1.07
			3 13 02	Raccoon Point	183 12 59	2818.9	3082.6	1.75
New Reef	28 36 55.36	82 43 49.74	191 17 55	Little Rock	11 18 15	5575.5	6097.2	3.46
			276 08 09	Raccoon Point	96 09 40	5220.0	5708.4	3.24
Beacon Rock	28 33 06.38	82 43 18.29	173 05 29	New Reef	353 05 14	7100.2	7764.6	4.41
			213 44 44	Raccoon Point	33 46 00	7805.4	8535.7	4.85
Bayport	28 31 58.42	82 40 25.69	114 02 36	Beacon Rock	294 01 14	5136.9	5617.5	3.19
			177 38 49	Raccoon Point	357 38 43	8588.7	9392.3	5.34
West Rock	28 29 57.21	82 44 35.08	199 43 04	Beacon Rock	19 43 31	6185.9	6764.7	3.84
			241 09 41	Bayport	61 11 40	7739.2	8463.4	4.81
Long Key	28 26 44.76	82 41 29.96	139 38 58	West Rock	319 37 30	7774.9	8502.4	4.83
			190 15 24	Bayport	10 15 55	9812.1	10730.2	6.10
Coral Rock	28 24 10.17	82 46 08.08	193 19 06	West Rock	13 19 50	10978.1	12005.4	6.82
			237 49 20	Long Key	57 51 33	8939.8	9776.3	5.55
Southeast Point	28 22 31.24	82 43 30.04	125 18 11	Coral Rock	305 16 56	5270.9	5764.1	3.27
			202 42 50	Long Key	22 43 47	8460.3	9251.9	5.26
Pelican Point	28 19 41.69	82 44 47.24	165 05 27	Coral Rock	345 04 48	8552.4	9352.6	5.31
			201 56 03	Southeast Point	21 56 39	5626.5	6153.0	3.50
South St. Martin	28 20 11.28	82 49 24.56	245 55 35	Southeast Point	65 58 23	10571.1	11560.2	6.57
			276 51 30	Pelican Point	96 53 42	7607.7	8319.5	4.73
Deer Island	28 15 33.54	82 46 23.37	150 00 37	South St. Martin	329 59 11	9872.1	10795.8	6.13
			198 55 13	Pelican Point	18 55 59	8075.0	8830.6	5.02
North Anclote	28 12 52.57	82 51 18.20	192 54 30	South St. Martin	12 55 24	13854.6	15151.0	8.61
			238 19 37	Deer Island	58 21 57	9441.6	10325.1	5.87
Tiger Point	28 11 27.48	82 48 47.90	122 35 27	North Anclote	302 34 16	4863.9	5319.0	3.02
			207 28 32	Deer Island	27 29 41	8537.6	9336.4	5.30
St. Martin 3	28 39 03.06	82 46 11.18	203 34 05	Chassahowitzka Point	23 35 04	8387.2	9172.0	5.21
			252 41 23	Little Rock	72 42 50	5166.6	5650.0	3.21
Line Key	28 35 40.09	82 40 37.97	179 22 27	Raccoon Point	359 22 27	1757.9	1922.4	1.09
			357 12 02	Bayport	177 12 08	6831.9	7471.2	4.24
Tangent Point	28 33 27.22	82 40 38.35	352 49 39	Bayport	172 49 45	2755.2	3013.0	1.71
			81 36 48	Beacon Rock	261 35 32	4394.2	4805.4	2.73
Outer Tripod	28 34 05.76	82 47 48.01	283 59 08	Beacon Rock	104 01 17	7554.5	8261.4	4.69
			325 33 31	West Rock	145 35 03	9275.9	10143.8	5.76
Barrel Stake	28 32 23.06	82 41 28.28	114 02 16	Beacon Rock	294 01 24	3273.9	3580.3	2.03
			294 01 41	Bayport	114 02 11	1862.9	2037.2	1.16
Barrel Beacon	28 32 28.08	82 41 53.17	117 00 17	Beacon Rock	296 59 36	2596.7	2839.6	1.61
			291 00 04	Bayport	111 00 46	2547.2	2785.6	1.58
Round Island	28 30 24.75	82 42 07.81	158 56 30	Beacon Rock	338 55 56	5331.5	5830.3	3.31
			351 21 12	Long Key	171 21 30	6849.6	7490.5	4.26
Harbor Rock	28 26 21.87	82 44 11.63	174 30 20	West Rock	354 30 09	6659.3	7282.4	4.14
			260 53 21	Long Key	80 54 38	4454.7	4871.5	2.77
Red Rock	28 26 55.56	82 46 05.51	203 44 17	West Rock	23 45 00	6108.5	6680.1	3.79
			288 30 07	Harbor Rock	108 31 01	3267.3	3573.0	2.03
Rainbow Point	28 28 09.68	82 42 04.38	70 50 07	Red Rock	250 48 12	6944.8	7594.6	4.32
			340 17 51	Long Key	160 18 07	2776.5	3036.3	1.73
Low Rock	28 27 56.54	82 44 01.61	262 45 49	Rainbow Point	82 46 45	3214.2	3515.0	2.00
			298 09 59	Long Key	118 11 11	4679.9	5117.8	2.91
Cedar Point	28 24 23.15	82 43 25.22	2 10 39	Southeast Point	182 10 37	3447.2	3769.8	2.14
			84 51 39	Coral Rock	264 50 22	4450.4	4866.8	2.77
Sand Ridge	28 29 50.05	82 41 00.18	29 28 38	Rainbow Point	209 28 07	3548.7	3880.7	2.20
			92 10 32	West Rock	272 08 49	5848.0	6395.1	3.63
Hammock Point	28 25 27.13	82 42 44.99	116 31 54	Red Rock	296 30 19	6097.3	6667.8	3.79
			192 26 51	Rainbow Point	12 27 10	5124.6	5604.1	3.18
South Anclote	28 10 19.40	82 51 23.65	181 48 12	North Anclote	1 48 14	4717.0	5158.3	2.93
			243 43 55	Tiger Point	63 45 08	4736.5	5179.7	2.94
Piny Point	28 10 00.75	82 48 46.57	97 38 24	South Anclote	277 37 10	4322.7	4727.2	2.69
			141 59 18	North Anclote	321 58 07	6713.3	7341.5	4.17

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VII.—St. Mark to St. Blas.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
ST. GEORGE ISLAND BASE, E. end	29 44 56.77	84 42 25.30						
ST. GEORGE ISLAND BASE, W. end	29 43 51.80	84 43 47.75	227 55 06	East Base	47 55 47	2984.6	3263.8	1.86
Royal Bluff	29 47 33.85	84 44 51.80	320 51 25	East Base	140 52 37	6234.9	6818.3	3.87
			345 52 11	West Base	165 52 43	7049.5	7709.1	4.38
Dog Island, (A. M.)	29 47 00.56	84 39 48.53	97 11 37	Royal Bluff	277 09 06	8208.7	8976.8	5.10
			47 51 43	East Base	227 50 25	5679.8	6211.2	3.53
Crooked River	29 49 56.04	84 40 32.10	347 46 46	Dog Island, (A. M.)	167 47 08	5528.0	6045.2	3.43
			57 53 43	Royal Bluff	237 51 34	8233.1	9003.5	5.12
Dog Island, East	29 49 23.19	84 34 44.35	61 45 22	Dog Island, (A. M.)	241 42 51	9273.4	10141.1	5.76
			96 12 26	Crooked River	276 09 33	9390.0	10268.6	5.84
Pine Tree	29 50 47.09	84 38 47.33	60 48 28	Crooked River	240 47 36	3221.6	3523.1	2.00
			13 15 40	Dog Island, (A. M.)	193 15 10	7165.4	7835.9	4.45
Palmetto Point	29 51 10.10	84 38 03.27	301 38 21	Dog Island, East	121 40 00	6272.5	6859.4	3.90
			20 12 08	Dog Island, (A. M.)	200 11 16	8186.3	8952.3	5.09
St. James Island	29 53 10.46	84 34 47.26	359 21 35	Dog Island, East	179 21 36	6997.8	7652.5	4.35
			54 50 46	Palmetto Point	234 49 09	6433.9	7036.0	4.00
Turkey Point	29 54 40.62	84 29 18.31	72 33 39	St. James Island	252 30 55	9250.6	10116.2	5.75
			41 51 25	Dog Island, East	221 48 43	13117.1	14344.5	8.15
Dog Island Light	29 46 50.73	84 38 37.97	56 31 14	West Base	236 28 40	9980.2	10914.0	6.20
			99 04 27	Dog Island, (A. M.)	279 03 52	1918.5	2098.0	1.19
Southwest Cape	29 53 32.82	84 22 30.19	100 49 30	Turkey Point	280 46 06	11145.1	12187.9	6.92
			68 44 28	Dog Island, East	248 38 22	21148.2	23127.0	13.14
Bailey	29 55 46.49	84 26 30.54	302 32 15	Southwest Cape	122 34 15	7648.4	8364.1	4.75
			65 45 09	Turkey Point	245 43 45	4935.5	5397.3	3.06
Peninsula Point	29 54 24.22	84 25 21.27	143 44 50	Bailey	323 44 15	3141.1	3435.0	1.95
			289 00 54	Southwest Cape	109 02 19	4854.5	5308.7	3.02
Franklin	29 55 20.70	84 24 36.34	314 27 41	Southwest Cape	134 28 44	4741.4	5185.0	2.95
			34 43 34	Peninsula Point	214 43 12	2115.7	2313.6	1.31
Jardella	29 53 29.20	84 29 33.23	229 12 24	Bailey	49 13 55	6471.6	7077.2	4.02
			255 54 42	Peninsula Point	75 56 48	6968.1	7620.1	4.33
Wells	29 54 52.52	84 22 13.72	10 12 27	Southwest Cape	190 12 19	2493.6	2726.9	1.55
			102 47 09	Franklin	282 45 58	3922.0	4289.0	2.44
Light-house Point	29 53 53.94	84 20 34.56	124 09 03	Wells	304 08 14	3213.7	3514.4	2.00
			78 10 00	Southwest Cape	258 09 02	3169.3	3465.9	1.97
Forbes	29 56 09.18	84 25 21.41	69 21 20	Bailey	249 20 45	1981.0	2166.4	1.23
			320 59 28	Franklin	140 59 51	1920.8	2100.6	1.19
Ellis	29 56 39.40	84 26 12.98	16 07 01	Bailey	196 06 52	1695.8	1854.4	1.05
			303 56 02	Forbes	123 56 28	1666.8	1822.7	1.04
Houston	29 57 19.69	84 25 33.23	40 40 53	Ellis	220 40 33	1635.5	1788.5	1.02
			351 41 54	Forbes	171 42 00	2193.9	2399.2	1.36
Robinson	29 58 06.17	84 26 43.28	343 05 04	Ellis	163 05 19	2792.3	3053.6	1.73
			307 18 09	Houston	127 18 44	2361.3	2582.2	1.47
Sopchoppy	29 59 02.36	84 25 03.91	57 00 18	Robinson	236 59 28	3176.1	3473.3	1.97
			13 57 39	Houston	193 57 24	3257.3	3562.1	2.02
Lansing	29 57 53.28	84 24 50.21	170 12 03	Sopchoppy	350 11 56	2158.1	2360.1	1.34
			97 27 53	Robinson	277 26 56	3057.1	3343.2	1.90
Piccoline Bayou	29 58 39.66	84 22 56.59	101 34 57	Sopchoppy	281 33 53	3483.5	3809.4	2.16
			64 53 29	Lansing	244 52 32	3363.7	3678.4	2.09
Chaires	29 57 38.94	84 22 50.27	174 48 59	Piccoline Bayou	354 48 56	1877.2	2052.9	1.17
			125 38 48	Sopchoppy	305 37 41	4408.1	4820.6	2.74
Ocklockony	29 58 14.36	84 21 17.20	106 18 22	Piccoline Bayou	286 17 32	2775.9	3035.6	1.73
			66 23 49	Chaires	246 23 02	2722.8	2977.6	1.69
Bald Point	29 56 54.39	84 20 20.70	148 24 15	Ocklockony	328 23 47	2890.7	3161.2	1.80
			127 48 20	Piccoline Bayou	307 47 02	5288.7	5783.6	3.29
Porter's Island	30 01 21.50	84 21 48.71	20 03 38	Piccoline Bayou	200 03 04	5304.7	5801.0	3.30
			343 59 24	Bald Point	164 00 08	8555.7	9356.2	5.32
Shell Point	30 03 26.58	84 17 15.41	62 16 26	Porter's Island	242 14 09	8272.2	9046.2	5.14
			22 21 57	Bald Point	202 20 24	13056.2	14277.9	8.11
St. Mark's Light	30 04 25.76	84 10 38 42	72 30 40	Porter's Island	252 25 04	18828.9	20590.6	11.70
			80 18 10	Shell Point	260 14 51	10786.8	11796.1	6.70

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VII.—St. Mark to St. Blas.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
West Bayou Point	30 06 37.61	84 12 58.41	317 16 37	St. Mark's Light	137 17 47	5525.3	6042.3	3.43
			49 29 48	Shell Point	229 27 39	9052.7	9899.8	5.63
New East River	30 06 34.53	84 09 17.88	90 56 07	West Bayou Point	270 54 17	5904.2	6456.7	3.67
			28 32 51	St. Mark's Light	208 32 11	4513.5	4935.8	2.80
Port Leon	30 07 30.69	84 11 27.21	56 12 22	West Bayou Point	236 11 36	2937.5	3212.4	1.83
			296 31 41	New East River	116 32 46	3869.7	4231.8	2.40
Walker	30 08 29.15	84 12 52.17	2 47 04	West Bayou Point	182 47 01	3438.3	3760.0	2.13
			308 21 53	Port Leon	128 22 36	2900.0	3171.3	1.81
South Base	30 08 32.58	84 11 49.47	342 38 36	Port Leon	162 38 47	1996.6	2183.4	1.24
			86 24 19	Walker	266 23 47	1681.2	1838.5	1.05
Fort St. Mark	30 09 01.32	84 12 30.47	308 52 53	South Base	128 53 14	1109.6	1541.5	0.87
			30 22 46	Walker	210 22 35	1148.0	1255.4	0.71
North Base	30 09 09.29	84 12 04.56	70 30 49	Fort St. Mark	250 30 36	735.5	804.3	0.46
			340 20 19	South Base	160 20 27	1200.2	1312.5	0.75
Near Astronomical Station	30 09 01.48	84 12 30.15	309 15 24	South Base	129 15 45	1405.9	1537.4	0.87
			250 38 15	North Base	70 38 28	725.7	793.6	0.45
St. Mark's Point	30 04 28.98	84 10 39.35	167 06 08	Port Leon	347 05 44	5740.3	6277.4	3.57
			209 25 23	New East River	29 26 36	4438.4	4853.7	2.76
Palmetto Island	30 05 04.45	84 06 48.79	124 48 24	New East River	304 47 09	4860.4	5315.1	3.02
			79 03 04	St. Mark's Light	259 01 09	6263.2	6849.2	3.89
Denham	30 06 45.34	84 07 24.28	342 59 36	Palmetto Island	162 59 54	3248.4	3552.4	2.02
			83 45 45	New East River	263 44 48	3059.0	3345.2	1.90
Torrey	30 05 56.42	84 04 23.81	107 19 51	Denham	287 18 21	5060.4	5533.9	3.15
			67 36 31	Palmetto Island	247 35 18	4198.5	4591.4	2.61
Gray Mares	30 04 44.53	84 05 14.69	211 36 20	Torrey	31 36 46	2599.0	2842.1	1.61
			103 41 14	Palmetto Island	283 40 27	2593.4	2836.0	1.61
Wacissa	30 05 50.26	84 00 20.75	75 35 57	Gray Mares	255 33 30	8126.2	8886.6	5.05
			91 41 09	Torrey	271 39 07	6510.0	7119.1	4.05
Ocilla River	30 04 38.17	83 59 13.11	106 10 32	Torrey	286 07 56	8661.6	9472.1	5.38
			91 10 50	Gray Mares	271 07 49	9683.9	10590.1	6.02
Cobb Rock	30 04 42.00	84 02 50.27	132 27 34	Torrey	312 26 47	3394.4	3712.0	2.11
			91 09 46	Gray Mares	271 08 33	3867.9	4229.8	2.40
Black and White Flag	30 06 03.88	84 03 20.80	82 15 09	Torrey	262 14 37	1702.5	1861.8	1.06
			51 18 24	Gray Mares	231 17 27	3907.2	4272.8	2.43
Marsh Point	29 46 04.87	84 47 43.90	302 50 13	West Base	122 52 11	7552.0	8258.7	4.69
			239 20 01	Royal Bluff	59 21 26	5372.9	5875.7	3.34
Gap Island	29 42 05.22	84 47 54.13	243 37 14	West Base	63 39 16	7389.9	8081.4	4.59
			182 08 04	Marsh Point	2 08 09	7383.5	8074.4	4.59
Cat Point	29 43 21.36	84 53 07.13	239 52 31	Marsh Point	59 55 12	10037.6	10976.8	6.24
			285 33 00	Gap Island	105 35 35	8732.0	9549.1	5.43
Bulkhead Point	29 40 14.71	84 51 21.34	238 34 10	Gap Island	58 35 53	6527.1	7137.9	4.06
			153 40 56	Cat Point	333 40 04	6411.2	7011.1	3.98
Cedar Point	29 38 57.61	84 55 03.53	201 04 09	Cat Point	21 05 07	8702.3	9516.6	5.41
			248 18 57	Bulkhead Point	68 20 47	6428.8	7030.3	3.99
Apalachicola, (astronomical station)	29 43 13.34	84 58 58.91	268 28 50	Cat Point	88 31 44	9457.1	10342.0	5.88
			321 11 43	Cedar Point	141 13 40	10101.0	11046.2	6.28
Middle Base	29 44 09.81	84 43 03.98	215 42 42	East Base	35 43 01	1780.5	1947.1	1.11
			314 45 48	West Base	244 45 26	1300.2	1421.8	0.81
New Inlet	29 36 07.35	84 59 43.87	235 10 35	Cedar Point	55 12 54	9183.7	10043.0	5.71
			185 15 49	Apalachicola	5 16 11	13170.8	14403.2	8.18
West Pass	29 37 32.29	85 05 37.30	285 21 12	New Inlet	105 24 07	9860.8	10783.5	6.13
			225 32 31	Apalachicola	45 35 48	14999.4	16402.9	9.32
Apalachicola, flagstaff	29 43 30.05	84 59 00.61	4 52 51	New Inlet	184 52 30	13679.2	14959.2	8.50
			322 45 18	Cedar Point	142 47 16	10534.4	11520.1	6.55
Godley's Bluff	29 44 11.22	84 53 54.17	77 44 37	Apalachicola	257 42 06	8380.5	9164.6	5.21
			10 56 04	Cedar Point	190 55 30	9833.8	10754.0	6.11
St. Mark's River	29 44 40.40	84 56 39.61	293 04 18	Cat Point	113 06 03	6207.0	6787.7	3.86
			346 14 33	Cedar Point	166 15 21	10864.9	11881.6	6.75
St. Vincent's Point	29 40 25.18	85 04 21.26	21 01 07	West Pass	201 00 29	5702.1	6235.6	3.55
			316 45 22	New Inlet	136 47 39	10893.5	11912.8	6.77

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VII.—St. Mark to St. Blas.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
St. George's Light	29 35 15.44	85 02 40.71	240 53 10 131 34 43	Cedar Point West Pass	60 56 56 311 33 16	14072.8 6349.7	15389.7 6943.8	8.75 3.94
St. George's Point	29 36 29.59	85 03 48.41	173 03 20 123 23 20	St. Vincent's Point West Pass	353 03 04 303 22 26	7306.7 3508.0	7990.4 3836.2	4.54 2.18
Pilot's Harbor	29 38 08.26	85 05 48.22	313 17 52 345 08 39	St. George's Point West Pass	133 18 51 165 08 44	4428.9 1145.7	4843.3 1252.9	2.75 0.71
Flag Island	29 37 09.83	85 08 29.49	279 17 06 261 29 59	St. George's Point West Pass	99 19 25 81 31 24	7662.5 4683.2	8379.4 5121.4	4.76 2.91
Green Point 1	29 42 23.73	85 01 59.11	46 19 22 342 34 02	St. Vincent's Point New Inlet	226 18 11 162 35 09	5284.5 12145.2	5779.0 13281.6	3.28 7.55
Green Point 2	29 42 24.03	85 01 58.20	4 53 51 299 37 43	St. George's Light Cedar Point	184 53 30 119 41 09	13243.4 12843.5	14482.6 14045.2	8.23 7.98
Orman's Point	29 43 06.30	85 05 06.29	284 35 22 346 17 06	Green Point 1 St. Vincent's Point	104 36 55 166 17 28	5198.6 5106.3	5685.0 5584.1	3.23 3.17
Middle Bayou	29 41 17.29	85 06 41.02	217 10 41 293 06 57	Orman's Point St. Vincent's Point	37 11 28 113 08 06	4212.7 4085.5	4606.9 4467.8	2.62 2.54
Oyster Cove	29 42 50.97	85 07 28.98	335 54 51 262 58 17	Middle Bayou Orman's Point	155 55 15 82 59 28	3159.1 3863.6	3454.7 4225.1	1.96 2.40
Shell Bank	29 42 01.32	85 10 23.93	282 43 50 256 47 19	Middle Bayou Orman's Point	102 45 40 76 49 56	6143.5 8768.5	6718.3 9589.0	3.82 5.45
Indian Pass	29 40 56.17	85 13 21.92	266 31 07 249 32 36	Middle Bayou Oyster Cove	86 34 26 69 35 31	10797.6 10124.8	11807.9 11072.1	6.71 6.29
Floyd	29 39 39.32	85 10 16.45	177 22 10 217 19 55	Shell Bank Oyster Cove	357 22 06 37 21 18	4376.2 7421.9	4785.7 8116.4	2.72 4.61
Ragged Point	29 41 39.19	85 13 12.57	307 55 17 261 26 36	Floyd Shell Bank	127 56 44 81 28 00	6003.3 4584.0	6565.0 5012.9	3.73 2.85
Dead Oak Point	29 41 06.19	85 16 37.54	284 36 09 259 92 11	Floyd Ragged Point	104 39 18 79 33 53	10589.1 5602.7	11580.0 6127.0	6.58 3.48
Cove	29 40 52.37	85 14 39.77	97 39 34 238 24 13	Dead Oak Point Ragged Point	277 38 36 58 24 56	3194.5 2751.7	3493.4 3009.2	1.98 1.71
Cape St. Blas Light	29 39 46.10	85 21 38.14	259 41 25 270 36 14	Cove Floyd	79 44 53 90 41 52	11431.3 18331.4	12500.8 20046.6	7.10 11.39

Section VII.—Pensacola and vicinity.

Name of station.	Latitude.	Longitude from Public Square flagstaff.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
PLANTATION HILL	30 22 07.83	E. 0 04 05.63						
TOWN POINT	30 22 14.55	E. 0 01 26.56	272 46 42	Plantation Hill	92 48 02	4252.0	4649.9	2.64
Barkley's Point	30 24 30.19	E. 0 00 23.40	306 26 44 338 00 51	Plantation Hill Town Point	126 28 36 158 01 23	7375.7 4503.8	8065.8 4925.3	4.58 2.80
Barkley No. 2, (approximate)	30 24 33.04	E. 0 00 22.01	306 54 02 338 04 54	Plantation Hill Town Point	126 55 55 158 05 27	7462.0 4608.0	8160.2 5039.1	4.64 2.86
Pensacola Wharf	30 24 16.75	E. 0 00 01.08	328 45 48 235 12 41	Town Point Barkley's Point	148 46 31 55 12 52	4400.4 725.2	4812.1 793.1	2.73 0.45
Pensacola Public Square, flag-staff.	30 24 32.98	0 00 00.00	277 50 21 356 40 35	Barkley's Point Pensacola Wharf	97 50 33 176 40 36	630.5 500.6	689.4 547.5	0.39 0.31
Bayou Chico	30 24 00.89	W. 0 01 16.56	306 55 47 256 43 37	Town Point Pensacola Wharf	126 57 09 76 44 16	5447.8 2129.3	5957.5 2328.6	3.38 1.32
Fair Point	30 21 44.13	E. 0 00 29.68	178 07 20 146 02 46	Barkley's Point Bayou Chico	358 07 17 326 01 52	5116.1 5077.0	5594.8 5552.0	3.18 3.15
Emanuel Point	30 25 19.57	E. 0 01 58.20	330 02 38 8 26 01	Plantation Hill Town Point	150 03 42 188 25 45	6813.5 5759.2	7451.0 6298.1	4.23 3.58
Middle Station	30 22 48.14	E. 0 04 40.95	78 44 38 137 02 22	Town Point Emanuel Point	258 43 00 317 01 00	5292.0 6372.6	5787.2 6968.8	3.29 3.96

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VII.—Pensacola and vicinity.

Name of station.	Latitude.	Longitude from Public Square Flagstaff.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Bayou Grande	30 23 00.86	W. 0 02 56.85	293 10 45	Fair Point	113 12 30	5998.9	6560.2	3.73
			242 45 19	Barkley's Point	62 47 00	6011.3	6573.8	3.74
Santa Rosa 2, (1856)	30 19 26.23	W. 0 00 44.97	205 08 56	Fair Point	25 09 34	4690.7	5129.6	2.91
			151 57 26	Bayou Grande	331 56 19	7488.2	8188.9	4.65
Navy Yard wharf	30 20 39.46	W. 0 03.11.34	299 58 00	Santa Rosa 2	119 59 14	4512.9	4935.2	2.80
			251 20 35	Fair Point	71 22 27	6228.8	6811.6	3.87
Fort Pickens	30 19 43.02	W. 0 04 35.95	232 25 47	Navy Yard wharf	52 26 30	2850.7	3117.5	1.77
			274 46 23	Santa Rosa 2	94 48 20	6191.0	6770.3	3.85
Lagoon	30 20 46.67	W. 0 05 19.07	273 42 37	Navy Yard wharf	93 43 41	3418.4	3738.3	2.12
			329 33 13	Fort Pickens	149 33 35	2273.1	2485.8	1.41
Fort Pickens, flagstaff	30 19 38.95	W. 0 04 36.17	151 12 32	Lagoon	331 12 10	2379.3	2602.0	1.48
			230 33 26	Navy Yard wharf	50 34 09	2933.4	3207.9	1.82
Fort McRae	30 19 33.88	W. 0 05 54.97	262 23 39	Fort Pickens	82 24 19	2129.4	2328.7	1.32
			245 11 11	Navy Yard wharf	65 12 34	4814.2	5264.7	2.99
West Base	30 20 56.67	W. 0 04 39.96	38 09 56	Fort McRae	218 09 18	3242.4	3545.8	2.01
			357 17 46	Fort Pickens	177 17 48	2270.4	2482.8	1.41
East Base	30 20 47.88	W. 0 03 28.89	59 43 21	Fort McRae	239 42 07	4517.9	4940.6	2.81
			98 07 17	West Base	278 06 41	1917.0	2096.4	1.19
Fort McRae, flagstaff	30 19 33.96	W. 0 05 55.25	239 46 37	East Base	59 47 51	4523.2	4946.4	2.81
			262 29 34	Fort Pickens	82 30 14	2136.3	2336.2	1.33
Fort St. Miguel	30 25 09.71	W. 0 00 11.48	334 06 39	Town Point	154 07 29	5994.2	6555.1	3.72
			350 08 50	Fair Point	170 09 11	6425.0	7026.2	3.99
Navy Yard, chimney	30 20 48.58	W. 0 03 13.71	207 50 04	Bayou Chico	27 51 03	6696.6	7323.2	4.16
			253 59 04	Fair Point	74 00 57	6205.8	6786.4	3.86
Naval Store	30 20 51.04	W. 0 03 17.29	45 05 28	Fort Pickens	225 04 48	2966.6	3244.2	1.84
			87 38 07	Lagoon	267 37 05	3255.1	3559.7	2.02
Battery Flagstaff	30 20 54.57	W. 0 03 06.81	255 12 04	Fair Point	75 13 53	5978.9	6538.3	3.71
			305 40 07	Santa Rosa 2	125 41 19	4663.5	5099.8	2.90
Warrington Flagstaff	30 20 50.30	W. 0 03 42 48	281 34 45	East Base	101 31 52	370.6	405.3	0.23
			34 35 16	Fort Pickens	214 34 49	2516.0	2751.5	1.56
Warrington Church	30 20 48.21	W. 0 03 42.76	35 17 46	Fort Pickens	215 17 19	2459.1	2689.3	1.53
			57 03 34	Fort McRae	237 02 27	4207.8	4601.5	2.61
Marine Hospital	30 20 59.67	W. 0 04 19.01	44 08 20	Fort McRae	224 07 32	3680.7	4025.1	2.29
			10 51 14	Fort Pickens	190 51 05	2403.1	2628.0	1.49
Fort St. Charles	30 20 52.90	W. 0 05 00.80	30 44 18	Fort McRae	210 43 51	2830.7	3095.6	1.76
			278 02 53	Navy Yard wharf	98 03 48	2952.2	3228.4	1.83
Barancas, Old Light-house	30 20 48.57	W. 0 05 15.03	332 38 59	Fort Pickens	152 39 19	2272.3	2484.9	1.41
			274 50 43	Navy Yard wharf	94 51 45	3315.1	3625.3	2.06
Redfish Point	30 23 59.72	E. 0 07 36.20	71 51 26	Town Point	251 48 19	10385.2	11357.0	6.45
			105 16 13	Emanuel Point	285 13 22	9349.6	10224.4	5.81
Garçon's Point	30 26 17.25	E. 0 07 18.31	33 07 26	Middle Station	213 06 16	7687.0	8406.2	4.78
			78 16 36	Emanuel Point	258 13 54	8724.2	9540.5	5.42
Santa Rosa 1, (1856 and 1859)	30 19 26.62	E. 0 01 10.30	89 47 12	Santa Rosa 2	269 46 14	3079.1	3367.3	1.91
			135 00 11	Bayou Grande	314 58 06	9331.3	10204.4	5.80
Santa Rosa 3, (1856)	30 19 43.39	E. 0 03 24.08	89 59 02	Fort Pickens	269 55 00	12821.2	14020.9	7.97
			120 53 39	Bayou Grande	300 50 26	11850.6	12959.5	7.36
Deer Point	30 20 33.92	E. 0 01 51.52	63 30 38	Santa Rosa 2	243 29 19	4670.5	5107.5	2.90
			120 27 36	Bayou Grande	300 25 10	8930.6	9766.3	5.55
Catholic Church	30 24 32.90	E. 0 00 01.97	278 17 23	Barkley's Point	98 17 34	578.1	632.2	0.36
			2 42 17	Pensacola wharf	182 42 17	497.7	544.3	0.31
Presbyterian Church	30 24 41.20	E. 0 00 11.51	316 52 49	Barkley's Point	136 52 55	464.3	507.7	0.29
			20 17 26	Pensacola wharf	200 17 21	802.4	877.5	0.50
Episcopal Church	30 24 24.05	E. 0 00 13.14	293 27 08	Barkley's Point	113 27 13	288.5	315.5	0.18
			31 08 50	Pensacola wharf	211 08 44	622.2	680.4	0.39
Market House	30 24 29.48	W. 0 00 01.63	268 07 00	Barkley's Point	88 07 13	668.5	731.1	0.41
			349 30 44	Pensacola wharf	169 30 45	398.5	435.8	0.25
West Beach	30 18 47.39	W. 0 07 59.73	252 31 08	Fort Pickens	72 32 51	5706.4	6240.3	3.55
			229 25 45	Lagoon	49 27 06	5648.0	6176.4	3.51

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section VII.—Pensacola and vicinity.

Name of station.	Latitude.	Longitude from Public Square Flagstaff.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Mainshore	30 19 33.92	W. 0 08 13.36	267 13 19	Fort Pickens	87 15 09	5813.9	6357.9	3.61
			345 43 57	West Beach	165 44 04	1478.1	1616.5	0.92
Hernandez	30 26 53.48	E. 0 06 38.61	24 54 42	Plantation Hill	204 53 25	9696.9	10604.2	6.03
			68 53 19	Emanuel Point	248 50 57	8021.1	8771.6	4.98
Devil's Point	30 29 29.23	E. 0 03 49.67	358 12 18	Plantation Hill	178 12 26	13597.6	14869.9	8.45
			316 46 18	Hernandez	136 47 44	6580.2	7195.9	4.09
Crawl Bayou	30 31 04.14	E. 0 06 51.28	58 53 52	Devil's Point	238 52 20	5655.8	6185.0	3.51
			2 30 29	Hernandez	182 30 23	7725.5	8448.4	4.80
Punta Lora	30 30 55.24	E. 0 03 09.53	267 19 47	Crawl Bayou	87 21 39	5918.0	6471.7	3.68
			337 59 38	Devil's Point	157 59 58	2856.6	3123.9	1.77
Live Oak Point	30 31 51.05	E. 0 04 59.94	23 13 25	Devil's Point	203 12 49	4751.8	5196.5	2.95
			295 56 22	Crawl Bayou	115 57 19	3300.8	3609.7	2.05
Emanuel Point 2	30 26 31.25	E. 0 02 25.20	341 42 26	Plantation Hill	161 43 17	8542.1	9341.4	5.31
			273 08 06	Garçon Point	93 10 35	7831.9	8564.8	4.87
Abercromby	30 28 04.35	E. 0 03 32.06	31 53 38	Emanuel Point 2	211 53 04	3376.1	3692.0	2.10
			298 38 08	Garçon Point	118 40 03	6877.6	7521.1	4.27
Santa Rosa 2, (1859)	30 19 58.58	E. 0 03 14.94	73 32 34	Santa Rosa 1	253 31 31	3471.7	3796.6	2.16
			116 02 06	Deer Point	296 01 24	2479.3	2711.3	1.54
Plantation 1	30 21 05.30	E. 0 03 06.98	354 05 26	Santa Rosa 2	174 05 30	2065.5	2258.7	1.28
			64 22 50	Deer Point	244 22 12	2234.8	2443.9	1.39
Santa Rosa 3, (1859)	30 20 25.10	E. 0 03 56.19	133 17 19	Plantation 1	313 16 54	1805.5	1974.4	1.12
			53 27 26	Santa Rosa 2	233 27 05	1371.4	1499.7	0.85
Plantation 2	30 21 41.27	E. 0 04 33.17	64 18 52	Plantation 1	244 18 08	2554.2	2793.2	1.59
			22 50 20	Santa Rosa 3	202 50 01	2544.6	2782.7	1.58
Santa Rosa 4, (1859)	30 20 31.31	E. 0 05 47.78	137 14 11	Plantation 2	317 13 33	2934.1	3208.7	1.82
			86 20 08	Santa Rosa 3	266 19 12	2986.3	3265.7	1.86
Plantation 3	30 21 55.56	E. 0 05 28.69	348 52 41	Santa Rosa 4	168 52 51	2643.7	2891.0	1.64
			73 27 58	Plantation 2	253 27 30	1546.3	1691.0	0.96

Section IX.—From Espiritu Santo Bay to Aransas Pass.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
ESPIRITU SANTO	28 22 58.87	96 30 41.17						
RAHAL	28 16 41.23	96 32 06.50	191 18 00	Espiritu Santo	11 18 40	11854.6	12963.7	7.37
Grass Island	28 18 48.20	96 40 08.13	243 24 28	Espiritu Santo	63 28 57	17259.9	18874.9	10.72
			286 33 18	Rahal	106 37 06	13691.6	14972.8	8.51
Panther Point	28 11 38.48	96 40 26.55	182 10 19	Grass Island	2 10 28	13236.7	14475.2	8.23
			235 36 34	Rahal	55 40 31	16512.1	18057.1	10.26
Sand Mounds	28 16 34.08	96 47 39.83	251 25 36	Grass Island	71 29 10	12980.4	14194.9	8.07
			307 34 52	Panther Point	127 38 17	14909.7	16304.8	9.26
Shell Island	28 16 37.67	96 43 41.72	235 21 48	Grass Island	55 23 29	7071.4	7733.0	4.39
			329 58 19	Panther Point	149 59 51	10635.8	11630.9	6.61
Mosquito Point	28 20 50.33	96 42 02.89	19 06 00	Shell Island	199 05 13	8229.9	8999.9	5.11
			49 20 52	Sand Mounds	229 18 12	12101.9	13234.3	7.52
Sharp's House	28 21 25.65	96 47 06.04	293 02 22	Grass Island	113 05 40	12370.4	13527.8	7.69
			277 29 04	Mosquito Point	97 31 28	8326.1	9105.2	5.17
Rice's House	28 25 02.74	96 44 30.41	332 39 25	Mosquito Point	152 40 35	8746.2	9564.6	5.43
			32 23 00	Sharp's House	212 21 46	7912.0	8652.3	4.92
Long Motts	28 27 04.30	96 45 44.17	331 47 25	Rice's House	151 48 00	4245.9	4643.1	2.64
			12 04 19	Sharp's House	192 03 40	10659.6	11657.0	6.62
Lower Guadalupe	28 26 48.22	96 46 43.70	253 00 29	Long Motts	73 00 58	1693.5	1851.9	1.05
			311 49 46	Rice's House	131 50 49	4867.8	5323.2	3.02
Peach Mott	28 28 04.47	96 46 31.92	324 57 02	Long Motts	144 57 25	2262.3	2474.0	1.41
			7 46 31	Lower Guadalupe	187 46 25	2368.7	2590.3	1.47

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section IX.—From Espiritu Santo Bay to Aransas Pass.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Mission Bay	28 28 09.11	96 49 07.04	271 55 48	Peach Mott	91 57 02	4221.7	4616.8	2.63
			289 51 41	Long Motts	109 53 18	5868.2	6417.3	3.64
High Palm	28 15 06.12	96 37 18.81	251 00 06	Rahal	71 02 34	9000.6	9842.8	5.60
			38 42 07	Panther Point	218 40 38	8188.2	8954.4	5.09
Signal Island	28 17 36.85	96 41 24.60	223 28 56	Grass Island	43 29 32	3026.8	3310.0	1.88
			276 23 18	Rahal	96 27 43	15302.6	16734.4	9.51
Cedar Bayou	28 06 06.73	96 48 27.30	183 49 55	Sand Mounds	3 50 17	19353.7	21164.5	12.03
			232 03 58	Panther Point	52 07 44	16622.1	18177.4	10.33
Mott Ranche	28 22 53.93	96 37 43.85	321 17 13	Rahal	141 19 53	14698.3	16073.7	9.13
			27 27 29	Grass Island	207 26 20	8523.5	9321.0	5.30
Dubois' Ranche	28 08 35.82	96 44 51.64	162 42 31	Sand Mounds	342 41 11	15419.1	16861.9	9.58
			232 07 00	Panther Point	52 09 05	9159.5	10016.6	5.69
Second Chain	28 11 09.81	96 48 23.94	186 51 58	Sand Mounds	6 52 19	10053.6	10994.3	6.25
			266 05 28	Panther Point	86 09 14	13049.0	14269.9	8.11
Ayer's Island	28 11 13.43	96 50 36.84	267 18 29	Panther Point	87 23 17	16661.2	18220.2	10.35
			339 28 02	Cedar Bayou	159 29 03	10080.3	11023.5	6.26
Brown's House	28 24 32.36	96 43 29.00	341 03 43	Mosquito Point	161 04 24	7225.4	7901.5	4.49
			45 48 22	Sharp's House	225 46 39	8242.4	9013.6	5.12
Marsh Point	28 23 53.27	96 46 12.79	309 35 54	Mosquito Point	129 37 53	8831.7	9658.1	5.49
			17 41 54	Sharp's House	197 41 29	4769.5	5215.8	2.96
Upper Guadalupe	28 27 33.46	96 47 16.95	110 07 51	Mission Bay	290 06 59	3189.2	3487.7	1.98
			232 04 38	Peach Mott	52 04 59	1552.8	1698.1	0.97
Duke's House	28 22 35.55	96 48 58.73	238 10 00	Rice's House	58 12 08	8594.5	9398.7	5.34
			305 01 53	Sharp's House	125 02 47	3747.3	4097.9	2.33
Huff's House, peaked roof	28 25 32.26	96 51 58.42	274 13 58	Rice's House	94 17 31	12225.1	13369.0	7.60
			313 37 35	Sharp's House	133 39 54	10998.3	12027.4	6.83
St. Charles	28 09 37 57	96 54 29.99	221 04 09	Sand Mounds	41 07 23	17012.3	18604.1	10.57
			303 13 53	Cedar Bayou	123 16 44	11834.6	12941.9	7.36
Littles	28 00 18.23	96 54 50.13	181 49 41	St. Charles	1 49 51	17225.7	18837.5	10.70
			224 14 07	Cedar Bayou	44 17 07	14978.4	16380.0	9.31
Ballou's House, or Lamar	28 08 05.74	96 59 07.51	249 30 31	St. Charles	69 32 42	8081.8	8838.1	5.02
			333 57 23	Littles	153 59 24	16014.1	17512.5	9.95
Big Mound	28 04 46.95	97 01 48.91	233 13 03	St. Charles	53 16 30	14949.5	16348.4	9.29
			305 50 59	Littles	125 54 16	14114.0	15434.7	8.77
Teal's House	28 08 33.51	96 58 11.00	251 52 28	St. Charles	71 54 12	6343.6	6937.1	3.94
			340 12 10	Littles	160 13 45	16201.2	17717.1	10.07
Eagle's Nest	28 11 39.10	96 57 23.75	308 16 26	St. Charles	128 17 48	6037.7	6602.6	3.75
			12 42 58	Teal's House	192 42 36	5856.4	6404.4	3.64
Bell Mott Bayou	28 10 25.65	96 55 36.80	50 38 13	Teal's House	230 37 00	5441.5	5950.6	3.38
			127 47 13	Eagle's Nest	307 46 22	3690.4	4035.7	2.29
Nine Mile Point	28 02 02.05	97 01 06.98	167 17 33	Big Mound	347 17 14	5203.3	5690.2	3.24
			287 13 21	Littles	107 16 18	10778.1	11786.6	6.70
Shell Bank	27 59 41.17	97 03 23.49	195 20 27	Big Mound	15 21 11	9760.1	10673.3	6.07
			265 19 01	Littles	85 23 02	14071.1	15387.8	8.74
Dry Pond	28 13 21.07	96 55 57.93	353 54.20	Bell Mott Bayou	175 54 30	5430.0	5938.1	3.37
			36 42 36	Eagle's Nest	216 41 55	3914.8	4281.1	2.43
Marsh Cove	28 14 10.89	96 56 53.18	315 30 37	Dry Pond	135 31 03	2149.4	2350.5	1.33
			10 06 52	Eagle's Nest	190 06 38	4745.8	5189.8	2.95
Vincent Land's House	28 03 42.05	96 51 27.84	155 34 52	St. Charles	335 33 26	12019.3	13143.9	7.47
			227 53 17	Cedar Bayou	47 54 42	6642.6	7264.1	4.13
St. Joseph	28 01 07.87	96 57 34.39	197 46 35	St. Charles	17 48 02	16476.6	18018.3	10.24
			238 20 20	Cedar Bayou	58 24 37	17543.4	19184.9	10.90
Long Reef	28 03 53.16	96 57 20.87	203 44 04	St. Charles	23 45 25	11581.6	12665.3	7.20
			254 12 10	Cedar Bayou	74 16 21	15135.0	16551.2	9.40
Poverty Reef	28 06 14.92	96 55 09.28	189 45 00	St. Charles	9 45 18	6329.1	6921.4	3.93
			271 17 24	Cedar Bayou	91 20 33	10974.4	12001.3	6.82
Lone Tree	28 15 47.31	96 56 04.29	357 47 46	Dry Pond	177 47 49	4504.9	4926.5	2.80
			15 50 04	Eagle's Nest	195 49 26	7941.3	8684.3	4.93
Five Mile Mott	28 11 41.73	96 58 45.44	236 11 18	Dry Pond	56 12 37	5496.2	6010.5	3.41
			294 27 48	Bell Mott Bayou	114 29 17	5652.7	6181.7	3.51

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section IX.—From Espiritu Santo Bay to Aransas Pass.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
Forked Tree	28 16 02.18	96 55 54.26	1 09 22	Dry Pond	181 09 20	4960.3	5424.4	3.08
			25 07 10	Marsh Cove	205 06 42	3783.6	4137.6	2.35
Salt Creek Mott	28 16 14.58	96 53 37.21	35 41 39	Dry Pond	215 40 32	6575.6	7190.8	4.09
			54 31 49	Marsh Cove	234 30 16	6559.5	7173.3	4.07
Two High Trees	28 12 15.82	96 54 44.61	22 46 14	Bell Mott Bayou	202 45 49	3677.5	4021.6	2.28
			75 24 48	Eagle's Nest	255 23 33	4484.1	4903.7	2.78
Gaston's House	28 08 53.80	96 52 38.03	82 05 57	Ballou's House	262 02 53	10728.9	11732.8	6.67
			113 48 35	St. Charles	293 47 42	3338.2	3650.6	2.07
Littles' House	28 01 08.45	96 54 10.62	118 17 03	Big Mound	298 13 28	14207.3	15536.7	8.83
			147 45 58	Ballou's House	327 43 38	15187.8	16608.9	9.44
Aransas Light	27 51 50.83	97 02 58.38	184 32 19	Big Mound	4 32 52	23964.2	26206.5	14.89
			177 17 10	Shell Bank	357 16 58	14493.1	15849.3	9.00
Robert's Lookout	27 53 55.40	97 01 02.16	220 46 03	Littles	40 48 58	15564.0	17020.3	9.67
			160 03 34	Shell Bank	340 02 28	11322.1	12381.4	7.04
Mud Island	27 56 09.35	97 02 04.27	181 30 27	Big Mound	1 30 34	15937.2	17428.4	9.90
			237 07 17	Littles	57 10 41	14121.7	15443.1	8.78
Thurmond's House	27 55 05.55	97 04 06.91	191 53 18	Big Mound	11 54 23	18288.3	19999.5	11.36
			237 39 05	Littles	57 43 26	18004.4	19689.0	11.19
Blind Pass	27 57 13.14	96 58 28.19	119 28 11	Shell Bank	299 25 53	9267.1	10134.2	5.76
			226 16 11	Littles	46 17 53	8243.6	9014.9	5.12
Rattlesnake Bluff	28 10 38.68	97 03 36.96	302 37 09	Ballou's House	122 39 16	8729.0	9545.7	5.42
			344 45 30	Big Mound	164 46 21	11220.6	12270.5	6.97
Copano House	28 08 46.68	97 07 15.71	275 22 23	Ballou's House	95 26 14	13379.4	14631.3	8.31
			309 34 55	Big Mound	129 37 29	11575.4	12658.4	7.19
Hannibal's Ranche	28 04 39.15	97 05 33.55	159 54 27	Copano House	339 53 39	8113.2	8872.4	5.04
			267 44 35	Big Mound	87 46 21	6137.2	6711.5	3.81
Ben Smith's House	28 04 28.92	97 03 42.42	143 44 55	Copano House	323 43 14	9840.4	10761.1	6.12
			180 44 59	Rattlesnake Bluff	0 45 02	11382.5	12447.5	7.07
Black Point House	28 05 23.68	97 12 26.03	233 33 27	Copano House	53 35 53	10524.3	11509.1	6.54
			273 40 37	Big Mound	93 45 37	17428.8	19059.6	10.83
Refugio	28 07 49.91	97 09 14.09	241 34 44	Copano House	61 35 40	3672.4	4016.0	2.28
			294 50 17	Big Mound	114 53 47	13391.0	14644.0	8.32
West Puerto	28 03 31.15	97 10 11.25	133 16 41	Black Point House	313 15 37	5053.1	5525.9	3.14
			206 14 50	Copano House	26 16 12	10825.8	11838.7	6.73
East Puerto	28 03 33.80	97 07 20.23	112 04 24	Black Point House	292 02 00	9007.2	9850.0	5.60
			89 00 37	West Puerto	268 59 17	4670.5	5107.5	2.90
Cattle Point	27 59 49.00	97 08 54.24	162 54 21	West Puerto	342 53 45	7154.1	7823.5	4.45
			200 21 07	East Puerto	20 21 51	7380.5	8071.1	4.59
Aransas River	28 03 41.72	97 13 10.75	201 15 15	Black Point House	21 15 36	3367.5	3682.6	2.09
			273 47 05	West Puerto	93 48 29	4911.7	5371.3	3.05
Live Oak Tree	28 06 54.20	97 02 10.46	246 11 13	Ballou's House	66 12 39	5456.4	5967.0	3.39
			351 27 26	Big Mound	171 27 36	3960.6	4331.2	2.46
Lap Reef	28 08 10.94	97 02 51.99	344 29 46	Big Mound	164 40 16	6510.4	7119.5	4.05
			164 54 27	Rattlesnake Bluff	344 54 06	4710.1	5150.8	2.93
Plummer's House	28 09 41.00	97 05 48.63	284 58 24	Ballou's House	105 01 33	11329.4	12389.4	7.04
			324 07 33	Big Mound	144 09 26	11167.5	12212.4	6.94
Castland's House	28 03 45.47	97 01 38.40	171 22 56	Big Mound	351 22 51	1914.0	2093.1	1.19
			299 44 50	Littles	119 48 02	12846.1	14048.1	7.98
Red Fish Cove	28 01 40.54	97 08 52.92	147 51 45	West Puerto	327 51 08	4020.9	4397.2	2.50
			215 58 33	East Puerto	35 59 17	4308.2	4711.3	2.68
Big Tree	28 05 14.32	97 03 07.59	91 07 07	Black Point House	271 02 44	15246.4	16673.0	9.47
			134 00 24	Copano House	313 58 27	9411.3	10291.9	5.85
Dorsey's House	28 10 29.24	97 10 01.78	304 51 28	Copano House	124 52 46	5521.7	6038.4	3.43
			345 08 20	Refugio	165 08 42	5073.8	5548.6	3.15
Lambert House	28 10 32.60	97 09 28.16	312 03 05	Copano House	132 04 08	4866.7	5322.0	3.02
			355 36 55	Refugio	175 37 02	5022.4	5492.3	3.12
Dagger Island	27 50 08.45	97 09 49.48	210 52 57	Shell Bank	30 55 57	20545.5	22467.8	12.77
			254 19 15	Aransas Light	74 22 27	11679.9	12772.7	7.26
Mustang Island	27 45 05.32	97 06 47.42	151 54 17	Dagger Island	331 52 52	10577.7	11567.4	6.57
			206 39 06	Aransas Light	26 40 53	13967.2	15274.1	8.68

UNITED STATES COAST SURVEY—GEOGRAPHICAL POSITIONS.

Section IX.—From Espiritu Santo Bay to Aransas Pass.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
McGloin's Bluff	27 49 37.12	97 12 54.55	259 12 20	Dagger Island	79 13 46	5154.8	5637.1	3.20
			309 45 11	Mustang Island	129 48 02	13075.8	14299.3	8.13
Flour Bluff	27 42 01.11	97 15 48.63	198 44 41	McGloin's Bluff	18 46 02	14822.8	16209.8	9.21
			249 02 00	Mustang Island	69 06 12	15870.2	17355.1	9.86
Corpus Christi Pass	27 37 34.70	97 11 26.15	138 45 31	Flour Bluff	318 43 29	10907.3	11927.9	6.78
			208 49 12	Mustang Island	28 51 21	15832.7	17314.2	9.84
Corpus Christi Light	27 47 53.79	97 23 23.32	259 29 15	McGloin's Bluff	79 34 09	17498.9	19136.3	10.87
			311 03 16	Flour Bluff	131 06 48	16518.3	18063.9	10.26
Clark's House	27 52 08.67	97 18 59.18	295 02 16	McGloin's Bluff	115 05 06	11012.1	12042.4	6.84
			344 24 09	Flour Bluff	164 25 38	19414.0	21230.6	12.06
Wells' House	27 54 02.92	97 00 43.71	42 11 00	Aransas Light	222 09 57	5485.7	5999.0	3.41
			157 15 12	Shell Bank	337 13 57	11290.2	12346.5	7.02
Lone Tree	27 55 53.96	97 07 15.53	21 36 13	Dagger Island	201 35 01	11438.2	12508.5	7.11
			222 10 43	Shell Bank	42 12 32	9440.5	10323.8	5.87
Harbor Island	27 51 20.82	97 06 27.39	260 48 25	Aransas Light	80 50 03	5791 8	6333.8	3.60
			2 42 58	Mustang Island	182 42 49	11570.6	12653.3	7.19
Five Mile Station	27 47 47.73	97 04 41.19	117 11 44	Dagger Island	297 09 20	9483.6	10371.0	5.89
			200 35 51	Aransas Light	20 36 39	7993.9	8741.9	4.97
Shamrock Point	27 45 46.63	97 09 46.87	179 29 31	Dagger Island	359 29 30	8059.0	8813.0	5.01
			224 53 40	Aransas Light	44 56 51	15831.4	17312.7	9.84
Mexican's Pole	27 43 47.09	97 08 04.75	166 16 55	Dagger Island	346 16 06	12083.1	13213.7	7.51
			209 22 07	Aransas Light	29 24 30	17088.4	18687.4	10.62
Priest's House	27 41 39.09	97 14 54.16	207 59 45	Dagger Island	28 02 07	17758.7	19420.3	11.03
			244 30 29	Mustang Island	64 34 15	14765.3	16146.9	9.18
Oso	27 42 41.66	97 18 18.28	225 20 02	Dagger Island	45 23 59	19573.6	21405.0	12.16
			286 55 31	Flour Bluff	106 56 41	4285.2	4686.2	2.66
Turner's House	27 51 31.09	97 15 43.27	0 28 47	Flour Bluff	180 28 44	17544.2	19185.8	10.90
			62 02 51	Corpus Christi Light	241 59 16	14254.8	15588.6	8.86
Ingleside Seminary, chimney	27 50 21.82	97 12 53.69	17 16 29	Flour Bluff	197 15 08	16138.6	17648.7	10.03
			75 13 43	Corpus Christi Light	255 08 49	17822.2	19489.8	11.07
Twelve Mile Mustang	27 42 17.51	97 08 53.24	25 43 01	Corpus Christi Pass	205 41 50	9660.4	10564.3	6.00
			87 29 14	Flour Bluff	267 26 01	11390.4	12456.1	7.08
Garlic's House	27 36 38.11	97 12 31.50	151 29 29	Flour Bluff	331 27 57	11314.5	12373.1	7.03
			225 48 12	Corpus Christi Pass	45 48 42	2499.0	2732.8	1.55
Four Mile Padre Island	27 33 48.91	97 13 20.32	164 59 15	Flour Bluff	344 58 06	15685.2	17152.8	9.75
			204 14 32	Corpus Christi Pass	24 15 25	7622.2	8335.4	4.74
Clubb's Station	27 30 41.80	97 15 05.54	176 46 08	Flour Bluff	356 45 48	20941.2	22900.6	13.01
			205 19 24	Corpus Christi Pass	25 21 06	14060.9	15376.6	8.74
Seven Mile Laguna Madre	27 35 25.70	97 17 27.25	192 30 56	Flour Bluff	12 31 42	12466.5	13632.9	7.75
			248 07 27	Corpus Christi Pass	68 10 14	10666.8	11664.9	6.63
Eagle Ranche	27 36 39.60	97 20 27.55	217 40 04	Flour Bluff	37 42 13	12504.1	13674.1	7.77
			263 26 48	Corpus Christi Pass	83 30 59	14939.1	16337.0	9.28
Water Hole	27 39 24.72	97 18 55.98	226 49 53	Flour Bluff	46 51 20	7037.1	7695.6	4.37
			285 19 41	Corpus Christi Pass	105 23 10	12786.1	13982.5	7.95
James' House	27 44 29.02	97 21 45.58	236 50 48	McGloin's Bluff	56 54 55	17356.0	18980.0	10.78
			294 56 48	Flour Bluff	114 59 34	10784.8	11793.9	6.70
Clay Bluff	27 51 35.81	97 28 25.92	246 13 50	Clark's House	86 18 15	15535.4	16989.0	9.65
			309 30 53	Corpus Christi Light	129 33 14	10735.7	11740.2	6.67
Rincon Point	27 50 03.06	97 22 21.75	272 54 29	McGloin's Bluff	92 58 54	15540.6	16994.7	9.66
			22 57 30	Corpus Christi Light	202 57 01	4320.9	4725.2	2.69
Nueces River	27 50 26.11	97 29 31.83	220 02 21	Clay Bluff	40 02 52	2802.5	3064.7	1.74
			294 54 38	Corpus Christi Light	114 57 30	11120.6	12161.1	6.91
Nueces Bay	27 52 30.50	97 3[illegible] 34.69	283 52 38	Clay Bluff	103 54 34	7009.5	7665.4	4.35
			307 25 03	Nueces River	127 26 29	6299.1	6888.5	3.91
Mean's House	27 53 39.29	97 31 18.67	333 49 05	Nueces River	153 49 55	6625.3	7245.2	4.12
			44 28 41	Nueces Bay	224 28 05	2967.3	3245.0	1.84
Shote's House	27 53 14.91	97 29 16.52	4 36 30	Nueces River	184 36 23	5212.4	5700.1	3.24
			75 51 22	Nueces Bay	255 49 49	5589.4	6112.4	3.47

UNITED STATES COAST SURVEY.—GEOGRAPHICAL POSITIONS.

Section IX.—East Bay, near Galveston.

Name of station.	Latitude.	Longitude.	Azimuth.	To station.	Back Azimuth.	Distance.	Distance.	Dist.
	° ′ ″	° ′ ″	° ′ ″		° ′ ″	*Metres.*	*Yards.*	*Miles.*
ROBINSON'S BAYOU	29 34 46.98	94 33 31.12						
ROLLOVER	29 30 16.73	94 30 01.14	145 49 18	Robinson's Bayou	325 47 35	10058.7	10999.9	6.25
Oyster Bayou	29 33 40.67	94 28 13.12	24 51 36	Rollover	204 50 43	6919.4	7566.9	4.30
			103 26 18	Robinson's Bayou	283 23 41	8798.3	9621.6	5.46
Midway	29 31 19.71	94 27 02.83	68 01 17	Rollover	247 59 49	5178.2	5662.8	3.22
			156 26 42	Oyster Bayou	336 26 07	4734.2	5177.2	2.94
East Bay Bayou	29 34 01.15	94 25 35.52	25 18 57	Midway	205 18 14	5497.9	6012.3	3.41
			81 33 18	Oyster Bayou	261 32 00	4288.4	4689.7	2.66
Northwest Bend	29 34 42.93	94 24 35.79	32 19 49	Midway	212 18 36	7403.5	8096.2	4.60
			71 52 11	Oyster Bayou	251 50 24	6155.4	6731.4	3.83
High Islands	29 33 32.21	94 23 04.68	131 36 44	Northwest Bend	311 35 59	3279.0	3585.8	2.04
			102 22 58	East Bay Bayou	282 21 44	4156.5	4545.4	2.58

APPENDIX No. 10.

GEOGRAPHICAL POSITIONS DETERMINED APPROXIMATELY IN WEST VIRGINIA, ILLINOIS, KENTUCKY, TENNESSEE, ALABAMA, MISSISSIPPI, AND MISSOURI.

The geographical positions in West Virginia, Ohio, and Maryland, were determined by Assistant G. W. Dean and Mr. Mosman in 1863–'64. The latitudes were observed by means of a Gambey circle and the longitudes by means of the electric telegraph from Washington, D. C. The positions in Illinois, Kentucky, Alabama, Tennessee, and Missouri were determined by Mr. A. T. Mosman in 1865, the latitudes with a Gambey theodolite, differences of longitudes by means of a chronometer.

Locality.	Latitude.	Longitude west of Washington.
	° ′ ″	m. s.
Clarksburg, W. V	39 16 57	13 09.6
Grafton, W. V	39 20 46	11 54.7
Cameron, W. V	39 49 49	14 05.4
Wheeling, W. V	40 04 05	14 42.3
Parkersburg, W. V	39 16 05	18 04.7
Point Pleasant, W. V	38 50 31	20 22.9
South Point, O	38 25 14	22 09.6
Gauley Bridge, W. V	38 09 14	16 49.8
Charleston, W. V	38 21 18	....
Cumberland, Md	39 39 15	6 49.5
Martinsburg, W. V	39 27 27	3 37.4

For the longitude of the Washington observatory, *5h. 8m.* 11.7*s.* west of Greenwich, may be taken.

Locality.	Latitude.	Longitude from Cairo, Ill. (— east; + west.)
	° ′ ″	m. s.
Florence, Ala	34 47 15	—5 57.7
Chickasaw, Ala	34 53 30	—4 19.1
Clifton, Tenn	35 23 17	—4 40.4
Johnsonville, Tenn	36 03 48	—4 45.9
Fort Henry, Tenn	36 30 22	—4 30.3
Twenty-seven mile island, Tenn. river	36 57 14	—3 47.4
Patterson's Landing, Ky	37 03 12	—3 04.4
Paducah, Ky	37 04 35	—2 17.9
Mound City, Ill	37 04 48	....
Cairo, Ill	36 59 49	0 00.0
Cape Girardeau, Mo	37 17 53	+1 26.7
Wittemberg, Mo	37 39 19	+1 27.6
Menard, Ill	37 53 48	+2 40.0
Illinois Station, Mo	38 17 21	+4 53.0

For the longitude of Cairo we may assume the approximate value 5^h 56^m 40^s west of Greenwich.

APPENDIX No. 11.

TYPE CURVES OF THE TIDES OF THE PACIFIC COAST OF THE UNITED STATES.

It is a matter of some difficulty to give a clear explanation of the tides of the Pacific coast for practical purposes, affected as they are with a large diurnal inequality. It has been thought that the accompanying diagrams (Sketch No. 26) would, with the following explanation, render the matter clearer to those who have occasion to use the tide tables published on the charts and in the reports of the Coast Survey.

Although the diagrams refer to San Diego, the rules, with proper modifications in the amounts of rise and fall and diurnal inequality, will apply to all parts of that coast, except the inland waters of the Straits of Fuca and vicinity.

Each of the three diagrams represents the average tidal curves at San Diego, California, for mean tide, spring tide, and neap tide—the first one giving them for the moon's declination at its average value; the second, for the moon's declination at its greatest value, north or south; and the third, at its least value, or when the moon is on the equator. A scale of feet for the heights is on the side of each diagram, and a scale of hours for the time at the top. Similar curves are traced by self-registering tide-gauges, in which a pencil connected with a float rising and falling with the water traces a line on a band of paper carried along by clock-work.

The arrangement of the three diagrams is the same. The sign ☽ on the scale of hours indicates the time of the moon's transit, upper or lower; *i. e., upper*, the one over the part of the meridian above the horizon; *lower*, over the meridian 180° in longitude from the place of observation. There are thus two transits, an upper and a lower one, in twenty-four hours.

The same succession of tides follows the upper transit when the moon's declination is north, and the lower transit when the moon's declination is south, and *vice versa*.

The heavy black horizontal lines near the top of the diagrams represent on the scale of hours the luni-tidal intervals of high and low water; that is, the time elapsed from the moon's transit to the time of high or low water, at an average. For high water this is called the "corrected establishment." The shorter horizontal lines under them represent the diurnal inequality, a correction depending on the moon's declination; vertical dotted lines show how this correction is applied, it being alternately added and subtracted to give the time of high and low water, or the highest and lowest points of the curve. Thus the first high water and the second low water happen later, and the first low and second high water earlier than if this correction did not exist.

The vertical heavy lines on the left of each diagram represent the mean rise and fall, (full line,) the mean rise and fall of spring tides, (broken line,) and the mean rise and fall of neap tides, (dotted line;) the first being the mean of all the tides observed, the second of all the tides at the full and change of the moon, and the third of all the tides at the moon's quarters. The shorter black lines accompanying each of the three lines of rise and fall represent the diurnal inequality to be subtracted or added for alternate tides, in the manner shown in the diagram. As may be seen, the diurnal inequality on each diagram is the same for mean, spring, and neap tides; but it varies with the moon's declination, being largest on the second diagram for the moon's greatest declination, and least on the third, where the moon's declination is zero. On the latter diagram, in fact, the diurnal inequality for the heights of low water disappears altogether.

The curve of neap tide on the second diagram shows how curiously one of the low waters is destroyed by the effect of the diurnal inequality, the water continuing to rise after the first high water to the second, the place of the intermediate low water being merely indicated by a slight inflexion in the curve.

APPENDIX No. 12.

HARVARD COLLEGE, *November* 25, 1865.

SIR: I send you the first determination of the values of $\Sigma_2 - p$ for the series of Pleiades occultations, 1838–'42; also the values for the last series, 1857–1861. Their small and consistent values show the excellence of the lunar tables and the superior precision of this class of observations. It comes up to our full expectation, and we may reasonably expect to determine by this method the elements of the lunar orbit, the coefficient of annual variation, and the moon's semidiameter with much greater accuracy than by any other known method.

For this purpose I enclose you the method of reduction, with all the formulæ and the application to an example. My only doubt remains as to whether the similarity of epoch of the correction of the coefficient of variation with that of the semidiameter, and the coincident changes of sign for occultations upon the moon's dark limb, which are the only ones to be used, may not diminish too much the accuracy of the corrections. It may be necessary to introduce a greater number of other occultations to remedy this defect.

Very respectfully, your obedient servant,

BENJAMIN PEIRCE.

Hon. A. D. Bache,

Superintendent of the Coast Survey, &c.

Values of $\Sigma_2 - p$ *for the period* 1838–1842.

Year.	Month.	Day of month.	Place.	No. of star.	$\Sigma_2 - p = \delta p$.	Year.	Month.	Day of month.	Place.	No. of star.	$\Sigma_2 - p = \delta p$.
					″						″
1842	April	13	Edinburgh	25	−0.25	1841	August	10	Hamburg	16	+1.27
	Do	13	do	35	−0.10		Do	10	do	18	+1.94
	Do	13	do	40	+0.58		Do	10	do	18	+0.81
	January	21	Washington	1	+0.45		Do	10	do	18	+0.43
	Do	21	do	4	+0.01		Do	10	do	20	+1.98
	Do	21	do	8	−0.02		Do	10	do	20	+1.93
	Do	21	do	11	+0.14		Do	10	do	27	+2.26
	Do	21	do	13	+0.47		Do	10	do	27	+2.19
	Do	21	do	14	+0.57		Do	10	do	27	+1.95
	Do	21	do	20	−0.50		Do	10	do	34	+1.55
	Do	21	Cambridge, A.	4	−0.82		Do	10	do	34	+1.49
1841	August	10	Altona	1	+0.61		Do	10	do	26	+0.61
	Do	10	do	1	+0.39		Do	10	do	33	+2.67
	Do	10	do	2	+2.76		Do	10	do	33	+2.34
	Do	10	do	2	+2.47		Do	10	do	42	+4.57
	Do	10	do	8	+1.81		Do	10	do	42	+4.55
	Do	10	do	8	+1.22		Do	10	do	42	+4.42
	Do	10	do	18	−1.02		Do	10	do	37	−1.13
	Do	10	do	23	+1.24		Do	10	do	37	−1.82
	Do	10	do	23	+1.05		Do	10	do	39	+0.89
	Do	10	do	27	+1.91		Do	10	do	39	+0.70
	Do	10	do	34	+1.92		Do	10	do	39	+0.17
	Do	10	do	34	+1.75		Do	10	do	46	+1.96
	Do	10	do	33	+2.65		Do	10	do	46	+1.79
	Do	10	do	33	+2.15		Do	10	do	44	+0.09
	Do	10	do	42	+4.53		Do	10	do	44	−0.16
	Do	10	do	42	+4.56		Do	10	do	45	−0.27
	Do	10	Berlin	1	+1.13		Do	10	do	45	−1.19
	Do	10	do	1	+1.13		Do	10	do	45	−1.10
	Do	10	do	2	+1.57		Do	10	do	50	+1.71
	Do	10	do	2	+1.22		Do	10	do	50	+1.49
	Do	10	do	2	+1.22		Do	10	do	50	+1.04
	Do	10	do	11	+1.83		Do	10	do	52	+0.62
	Do	10	do	11	+1.46		Do	10	do	52	+0.42
	Do	10	do	11	+1.46		Do	10	do	52	−0.28
	Do	10	do	34	+1.68		Do	10	Geneva	1	+2.11
	Do	10	do	33	−0.08		Do	10	do	2	+1.39
	Do	10	Edinburgh	1	+1.95		Do	10	do	2	+0.06
	Do	10	do	2	+1.07		Do	10	do	8	+2.76
	Do	10	do	11	+2.30		Do	10	do	8	+2.72
	Do	10	do	7	+1.86		Do	10	do	15	+1.87
	Do	10	do	42	+2.18		Do	10	do	27	+1.67
	Do	10	Hamburg	1	+0.90		Do	10	do	24	+0.42
	Do	10	do	1	+0.65		Do	10	Leyden	1	+1.50
	Do	10	do	1	+0.42		Do	10	do	2	+3.79
	Do	10	do	2	+2.36		Do	10	Pulkova	2	+0.89
	Do	10	do	2	+2.32		Do	10	do	1	+0.51
	Do	10	do	2	+2.07		Do	10	do	8	−1.38
	Do	10	do	17	+2.58		Do	10	do	11	+0.70
	Do	10	do	17	+2.53		Do	10	do	34	+1.96
	Do	10	do	12	+3.10		Do	10	do	27	+1.96
	Do	10	do	8	+1.97		Do	10	do	20	+0.96
	Do	10	do	11	+0.99		Do	10	do	33	+0.53
	Do	10	do	11	+0.85		February	27	Edinburgh	4	−0.12
	Do	10	do	11	+0.68		Do	27	do	14	+2.62
	Do	10	do	15	−3.35		Do	27	do	11	+1.18
	Do	10	do	15	−3.53		Do	27	Leyden	4	−0.30
	Do	10	do	16	+1.75	1840	December	7	Breslau	1	−6.04
	Do	10	do	16	+1.27		Do	7	do	4	+3.32

APPENDIX No. 12—Continued.

Values of $\Sigma_2 - p$ *for the period* 1838–'42—Continued.

Year.	Month.	Day of month.	Place.	No. of star.	$\Sigma_2 - p = \delta p$.	Year.	Month.	Day of month.	Place.	No. of star.	$\Sigma_2 - p = \delta p$.
					″						″
1840	December..	7	Breslau	4	+4.92	1840	January	14	Konigsberg	14	+3.35
	Do	7	do	11	+1.28		Do	14	do	14	+3.38
	Do	7	do	11	+1.41		Do	14	do	3	+2.15
	Do	7	do	14	+1.97		Do	14	do	3	+2.31
	Do	7	do	20	+4.62		Do	14	do	11	+1.56
	Do	7	Copenhagen	4	+2.80		Do	14	do	11	+1.59
	Do	7	do	11	+4.96		Do	14	do	11	+1.66
	Do	7	Kremsmunster	1	+2.33		Do	14	do	20	+0.22
	Do	7	do	4	+0.77		Do	14	do	29	+3.32
	Do	7	do	8	−1.10		Do	14	Vienna	4	+2.11
	Do	7	do	11	+2.96		Do	14	do	14	+2.00
	October	13	Ashurst	1	+5.35	1839	September	16	Greenwich	1	−0.09
	Do	13	do	4	−0.94		Do	16	do	1	−0.16
	Do	13	do	11	+1.26		Do	16	do	4	−2.93
	Do	13	do	13	−0.83		Do	16	do	11	+0.21
	Do	13	do	14	−1.30		Do	16	Cambridge, E.	1	−1.11
	Do	13	do	20	+0.32		Do	16	do	4	−3.87
	Do	13	Breslau	1	−5.98		Do	16	do	11	−0.49
	Do	13	do	11	+1.65		Do	16	Ashurst	1	−0.33
	Do	13	Greenwich	1	+1.06		Do	16	do	4	−4.28
	Do	13	do	4	−0.42		Do	16	do	11	−0.27
	Do	13	do	4	−2.49		Do	16	Washington	2	−2.32
	Do	13	do	11	+1.64		Do	16	do	1	−2.10
	Do	13	do	11	+1.45		Do	16	do	4	−1.95
	Do	13	do	11	+1.14		Do	16	do	11	−3.45
	Do	13	Cambridge, A.	11	−0.61		Do	16	Philadelphia	2	−0.37
	Do	13	do	34	+0.13		Do	16	do	2	−2.08
	Do	13	Washington	34	+2.00		Do	16	do	2	−0.97
	January	14	Berlin	4	+0.98		Do	16	do	2	−0.49
	Do	14	do	3	+1.78		Do	16	do	1	−3.11
	Do	14	do	13	+3.93		Do	16	do	1	−3.44
	Do	14	do	14	+2.12		Do	16	do	1	−4.39
	Do	14	Bonn	4	+4.51		Do	16	do	1	−3.14
	Do	14	do	3	+1.42		Do	16	do	4	−2.65
	Do	14	do	13	+1.21		Do	16	do	4	−2.89
	Do	14	do	14	+1.26		Do	16	do	4	−3.25
	Do	14	Grifswald	4	−5.22		Do	16	do	4	−2.81
	Do	14	do	3	+3.41		Do	16	do	11	−3.15
	Do	14	Breslau	4	+3.79		Do	16	do	11	−3.02
	Do	14	do	4	+0.19		Do	16	do	11	−2.92
	Do	14	do	4	−0.17		Do	16	Boston	2	+0.18
	Do	14	do	3	+0.62		Do	16	do	1	−4.07
	Do	14	do	13	+1.42		Do	16	do	4	−3.44
	Do	14	do	14	+5.05		Do	16	do	11	−3.07
	Do	14	do	20	+2.62		August	30	Breslau	1	+0.86
	Do	14	do	20	+2.71		Do	30	do	11	+1.25
	Do	14	Cracow	4	+0.06		Do	30	do	17	−1.06
	Do	14	do	13	+1.15		Do	30	do	17	−1.33
	Do	14	do	14	+0.28		Do	30	do	27	+3.49
	Do	14	do	20	+1.52		Do	30	do	34	−0.83
	Do	14	Hamburg	4	+1.03		Do	30	do	42	+0.16
	Do	14	do	13	+3.56		Do	30	do	42	+0.19
	Do	14	do	3	+2.69		Do	30	Cambridge, E.	17	−0.87
	Do	14	do	3	+2.80		Do	30	do	17	−1.20
	Do	14	do	14	+2.97		Do	30	Rostock	17	−2.99
	Do	14	do	14	+3.06		Do	30	Leyden	33	−2.71
	Do	14	do	11	+4.15		Do	30	do	41	+1.12
	Do	14	do	11	+4.16		July	6	Hudson	2	−1.08
	Do	14	Kremsmunster	4	+1.51		Do	6	do	11	+0.67
	Do	14	do	13	−0.89		Do	6	Philadelphia	2	−3.62
	Do	14	do	14	+2.05		Do	6	Washington	2	−2.10
	Do	14	do	20	+2.40		Do	6	do	11	−6.30
	Do	14	Leyden	4	+0.34		March	19	Dorpat	2	+5.60
	Do	14	Konigsberg	4	+3.30		Do	19	do	2	+5.77
	Do	14	do	4	+3.53		Do	19	do	2	+5.85
	Do	14	do	1	+4.14		Do	19	do	2	+5.51
	Do	14	do	1	+4.16		Do	19	do	5	+4.13
	Do	14	do	1	+4.24		Do	19	do	5	+4.25
	Do	14	do	13	+1.36		Do	19	do	7	+4.71
	Do	14	do	13	+1.82		Do	19	do	12	+4.52
	Do	14	do	14	+3.15		Do	19	do	17	+5.33
	Do	14	do	14	+3.24		Do	19	do	17	+5.61

APPENDIX No. 12—Continued.

Values of Σ_2-p *for the period* 1838–'42—Continued.

Year.	Month.	Day of month.	Place.	No. of star.	Σ_2-p $=\delta p$.	Year.	Month.	Day of month.	Place.	No. of star.	Σ_2-p $=\delta p$.
					″						″
1839	March	19	Dorpat	17	+5.72	1839	March	19	Dorpat	50	+5.60
	Do	19	....do	17	+5.73		Do	19	Greenwich	2	+7.23
	Do	19	....do	15	+5.14		Do	19	....do	11	+6.89
	Do	19	....do	15	+5.30		Do	19	....do	4	+2.87
	Do	19	....do	16	+4.87		Do	19	....do	34	+6.48
	Do	19	....do	16	+4.97		Do	19	....do	42	+6.60
	Do	19	....do	19	+9.98	1838	December	27	Edinburgh	17	+2.94
	Do	19	....do	18	+5.03		Do	27	....do	25	+4.54
	Do	19	....do	21	+2.43		Do	27	....do	40	+1.99
	Do	19	....do	23	+3.93		Do	27	....do	41	+3.59
	Do	19	....do	27	+4.67		Do	27	....do	34	+5.84
	Do	19	....do	27	+5.10		Do	27	....do	42	+2.37
	Do	19	....do	27	+5.21		Do	27	Cambridge, E.	17	+2.96
	Do	19	....do	27	+5.16		Do	27	....do	34	+2.54
	Do	19	....do	26	+5.20		Do	27	....do	41	+3.22
	Do	19	....do	34	+5.03		Do	27	....do	42	+2.90
	Do	19	....do	34	+5.33		Do	27	Ashurst	17	+3.14
	Do	19	....do	34	+5.39		Do	27	....do	34	+2.56
	Do	19	....do	31	+4.44		Do	27	....do	27	+2.21
	Do	19	....do	33	+5.05		Do	27	....do	42	+3.61
	Do	19	....do	33	+5.18		Do	27	Philadelphia	34	+4.04
	Do	19	....do	24	+5.71		Do	27	....do	41	+3.75
	Do	19	....do	39	+5.16		Do	27	....do	41	+4.06
	Do	19	....do	42	+5.24		Do	27	....do	42	+1.83
	Do	19	....do	42	+5.43		Do	27	....do	42	+2.36
	Do	19	....do	42	+5.61		November	2	....do	17	—1.74
	Do	19	....do	42	+5.43		Do	2	....do	34	—6.79
	Do	19	....do	41	+5.34		Do	2	....do	41	—1.42
	Do	19	....do	41	+5.64		Do	2	....do	42	—3.67
	Do	19	....do	46	+4.74						

Values of Σ_2-p *for the period* 1857–1861.

Year.	Month.	Day of month.	Place.	No. of star.	Σ_2-p $=\delta p$.	Year.	Month.	Day of month.	Place.	No. of star.	Σ_2-p $=\delta p$.
					″						″
1857	January	6	Madras	41	—0.23	1857	March	1	San Francisco	12	—5.25
	Do	6	....do	42	—2.21		Do	1	....do	17	—7.35
	Do	6	....do	39	—2.03		Do	1	....do	21	—6.65
	Do	6	....do	46	—1.33		Do	1	....do	16	—3.06
	March	1	Ann Arbor	17	—4.14		Do	1	....do	15	—2.65
	Do	1	....do	25	—6.66		Do	1	....do	31	—4.97
	Do	1	....do	28	—5.31		Do	1	....do	28	—4.51
	Do	1	....do	32	—4.45		Do	1	....do	23	—5.05
	Do	1	....do	31	—3.98		Do	1	....do	27	—5.21
	Do	1	....do	35	—3.50		Do	1	....do	26	—4.31
	Do	1	....do	21	—3.96		Do	1	....do	34	—5.40
	Do	1	....do	43	—5.24		Do	1	....do	25	—1.97
	Do	1	....do	47	—3.23		Do	1	....do	41	—5.84
	Do	1	....do	41	—3.25		Do	1	....do	40	—1.53
	Do	1	....do	51	—5.06		Do	1	....do	42	—5.23
	Do	1	Galveston	2	—2.59		Do	1	....do	43	—2.96
	Do	1	....do	17	—6.19		Do	1	....do	46	—4.58
	Do	1	....do	31	—3.28		Do	1	....do	51	—2.76
	Do	1	....do	27	—4.37		Do	1	....do	50	—3.45
	Do	1	....do	34	—5.18		Do	1	....do	53	—3.54
	Do	1	....do	41	—3.96		Do	1	Montgomery	2	—1.38
	Do	1	....do	40	—0.25		Do	1	....do	17	—4.25
	Do	1	....do	42	—3.65		Do	1	....do	41	—3.00
	Do	1	Mobile	2	—2.03		August	12	Ann Arbor	17	—0.08
	Do	1	....do	17	—4.89		Do	12	....do	31	—0.21
	Do	1	....do	34	—3.03		Do	12	....do	43	+0.78
	Do	1	....do	41	—3.11		Do	12	....do	41	+1.31
	Do	1	....do	42	—2.13		Do	12	....do	42	—0.24
	Do	1	San Francisco	5	—4.13		Do	12	....do	46	—0.18
	Do	1	....do	2	—2.41		Do	12	....do	50	+2.17

APPENDIX No. 12—Continued.

Values of $\Sigma_2 - p$ *for the period* 1857–'61—Continued.

Year.	Month.	Day of month.	Place.	No. of star.	$\Sigma_2 - p = \delta p$.
					″
1857	August	12	Ann Arbor	48	−0.29
	Do	12	....do	49	+1.00
	Do	12	Newport, Mo.	17	−3.56
	Do	12	....do	41	−2.29
	October	6	St. Petersburg	17	−1.66
	Do	6	Wilna	17	−0.19
	Do	6	....do	42	−1.08
	Do	6	....do	41	+0.17
	Do	6	Brussels	42	+0.52
	Do	6	....do	41	−1.32
	Do	6	Greenwich	41	−2.22
	Do	6	....do	41	−2.24
	Do	6	....do	41	−2.29
	Do	6	Madras	2	−2.43
	Do	6	....do	1	−1.76
	Do	6	....do	4	+2.82
	Do	6	....do	11	−3.86
	November	2	Hanover	2	−1.58
	Do	2	Charleston	1	−2.98
	Do	2	....do	4	−2.64
	Do	2	Cambridge, A.	1	0.00
	Do	2	....do	2	+0.43
	Do	2	....do	17	+0.78
	Do	2	....do	12	+1.54
	Do	2	....do	11	−0.52
	Do	2	....do	16	−2.80
	Do	2	....do	18	+1.56
	Do	2	....do	27	+0.59
	Do	2	....do	34	+0.51
	Do	2	....do	26	+0.32
	December	27	West Haverford	2	−3.95
	Do	27	....do	4	−4.94
	Do	27	....do	11	−6.37
	Do	27	....do	13	−5.67
	Do	27	Southwick	2	−4.17
	Do	27	Nantucket	1	−5.11
	Do	27	....do	2	−2.49
	Do	27	....do	4	−4.56
	Do	27	....do	11	−5.25
	Do	27	....do	14	−9.00
	Do	27	Hanover	2	−4.14
	Do	27	....do	11	−5.44
	Do	27	Burlington	2	−2.89
	Do	27	Williamstown	2	−2.98
	Do	27	....do	4	−2.03
	Do	27	....do	11	−3.96
	Do	27	Charleston	4	−6.99
	Do	27	....do	11	−4.87
	Do	27	....do	13	−8.11
	Do	27	....do	14	−7.01
	Do	27	....do	20	−5.94
	Do	27	New York	2	−3.69
	Do	27	....do	4	−4.30
	Do	27	....do	11	−6.26
	Do	27	Fredericton	2	−0.81
	Do	27	....do	1	−4.47
	Do	27	....do	4	−2.09
	Do	27	....do	11	−5.36
	Do	27	....do	13	−2.82
	Do	27	....do	33	+1.11
	Do	27	....do	34	+1.41
	Do	27	Christiania	27	−3.13
	Do	27	....do	34	−3.13
	Do	27	....do	34	−4.59
	Do	27	....do	41	−5.11
	Do	27	West Point	2	−3.70
	Do	27	....do	4	−2.74
	Do	27	....do	11	−3.42
	Do	27	New Orleans	1	−2.12
	Do	27	....do	4	−5.39
	Do	27	....do	11	−3.18
1857	December	27	St. Petersburg	17	+10.83
	Do	27	Cambridge, A.	2	−4.57
	Do	27	....do	4	−4.78
	Do	27	....do	8	−6.59
	Do	27	....do	11	−5.90
	Do	27	....do	15	−5.34
	Do	27	....do	16	−4.79
	Do	27	....do	13	−7.44
	Do	27	....do	14	−1.32
	Do	27	....do	18	−4.12
	Do	27	....do	20	−4.65
	Do	27	....do	33	−3.66
	Do	27	....do	1	−6.25
	Do	27	....do	2	−4.75
	Do	27	....do	4	−5.07
	Do	27	....do	8	−6.32
	Do	27	....do	11	−6.46
	Do	27	....do	4	−4.61
	Do	27	....do	11	−5.75
	Do	27	....do	14	−1.47
1858	February	20	Dorpat	1	−4.42
	Do	20	....do	1	−4.35
	Do	20	....do	4	−4.79
	Do	20	....do	8	−3.75
	Do	20	....do	11	−5.02
	Do	20	....do	11	−4.82
	Do	20	....do	13	−5.06
	Do	20	....do	14	−4.95
	Do	20	....do	18	−3.69
	Do	20	....do	15	−1.53
	Do	20	....do	16	+0.50
	Do	20	....do	29	−5.28
	Do	20	....do	33	−3.88
	Do	20	....do	37	−5.08
	Do	20	....do	39	−3.89
	Do	20	Altona	1	−2.89
	Do	20	....do	4	−4.93
	Do	20	....do	4	−4.83
	Do	20	....do	4	−4.77
	Do	20	....do	8	−4.80
	Do	20	....do	8	−4.76
	Do	20	....do	8	−4.60
	Do	20	....do	11	−2.67
	Do	20	....do	11	−2.47
	Do	20	....do	11	−2.59
	Do	20	....do	13	−5.19
	Do	20	....do	13	−5.15
	Do	20	....do	14	−4.36
	Do	20	....do	14	−4.29
	Do	20	....do	14	−4.12
	Do	20	....do	20	−5.17
	Do	20	....do	20	−5.03
	Do	20	....do	20	−5.09
	Do	20	....do	29	−5.22
	Do	20	....do	29	−5.19
	Do	20	....do	29	−5.20
	Do	20	....do	30	−4.96
	Do	20	....do	30	−4.85
	Do	20	Berlin	1	−5.18
	Do	20	....do	4	−6.11
	Do	20	....do	4	−6.26
	Do	20	....do	8	−6.06
	Do	20	....do	8	−5.94
	Do	20	....do	11	−4.94
	Do	20	....do	11	−4.80
	Do	20	....do	11	−4.83
	Do	20	....do	10	−3.69
	Do	20	....do	13	−6.65
	Do	20	....do	13	−6.85
	Do	20	....do	13	−6.55
	Do	20	....do	14	−5.13

APPENDIX No. 12—Continued.

Values of $\Sigma_2 - p$ for the period 1857–'61—Continued.

Year.	Month.	Day of month.	Place.	No. of star.	$\Sigma_2 - p = \delta p$.	Year.	Month.	Day of month.	Place.	No. of star.	$\Sigma_2 - p = \delta p$.
					"						"
1858	February ..	20	Berlin	14	—5.02	1858	March.....	19	Williamstown .	14	—2.43
	Do......	20	....do	14	—5.21		Do......	19	....do	20	—1.16
	Do......	20	....do	20	—4.67		Do......	19	....do	30	—0.02
	Do......	20	Kremsmunster.	8	—5.09		Do......	19	....do	29	—2.82
	Do......	20	....do	11	—3.90		Do......	19	Hanover......	4	—4.09
	Do......	20	....do	20	—7.58		Do......	19	....do	3	—1.08
	Do......	20	....do	29	—3.34		Do......	19	....do	13	—2.57
	Do......	20	....do	30	—5.89		Do......	19	....do	14	—2.72
	Do......	20	Prague	1	—7.20		Do......	19	....do	20	—2.51
	Do......	20	....do	1	—7.18		Do......	19	....do	29	—3.08
	Do......	20	....do	4	—6.17		Do......	19	Fredericton ...	4	—1.52
	Do......	20	....do	8	—5.56		Do......	19	....do	6	—2.23
	Do......	20	....do	13	—6.98		Do......	19	....do	13	—1.44
	Do......	20	....do	13	—7.34		Do......	19	....do	3	—0.92
	Do......	20	....do	11	—6.69		Do......	19	....do	14	—0.51
	Do......	20	....do	11	—6.50		Do......	19	....do	11	—2.20
	Do......	20	....do	14	—5.96		Do......	19	....do	8	+0.09
	Do......	20	....do	44	—5.88		Do......	19	....do	20	—3.07
	Do......	20	Gottingen.....	11	—5.78		Do......	19	....do	29	+0.14
	Do......	20	....do	11	—5.68		Do......	19	....do	30	—1.83
	Do......	20	....do	11	—5.71		Do......	19	Ann Arbor	4	—3.45
	Do......	20	....do	11	—5.49		Do......	19	....do	29	—3.58
	Do......	20	....do	13	—6.03		Do......	19	Cambridge, A .	4	—2.44
	Do......	20	....do	13	—6.03		Do......	19	....do	3	—1.26
	Do......	20	....do	13	—6.11		Do......	19	....do	6	—1.51
	Do......	20	....do	13	—5.70		Do......	19	....do	13	—4.84
	Do......	20	....do	14	—5.08		Do......	19	....do	14	—3.68
	Do......	20	....do	14	—4.77		Do......	19	....do	20	—2.98
	Do......	20	....do	20	—3.89		Do......	19	....do	30	—0.95
	Do......	20	....do	20	—3.63		Do......	19	....do	29	—3.92
	Do......	20	....do	29	—4.04		Do......	19	....do	4	—2.69
	Do......	20	....do	30	—4.09		Do......	19	....do	3	—1.50
	Do......	20	Bonn..........	8	—5.79		Do......	19	....do	6	—1.57
	Do......	20	....do	11	—6.82		Do......	19	....do	13	—4.92
	Do......	20	....do	11	—6.91		Do......	19	....do	14	—4.39
	Do......	20	....do	11	—6.75		Do......	19	....do	20	—3.15
	Do......	20	....do	13	—6.70		Do......	19	....do	30	—0.94
	Do......	20	....do	13	—6.84		Do......	19	....do	29	—4.00
	Do......	20	....do	14	—6.00		Do......	19	....do	4	—2.61
	Do......	20	....do	14	—6.08		Do......	19	....do	3	—1.34
	Do......	20	....do	20	—3.71		Do......	19	....do	13	—4.74
	Do......	20	....do	20	—3.88		Do......	19	....do	14	—4.53
	Do......	20	....do	20	—3.72		Do......	19	....do	20	—3.05
	Do......	20	....do	29	—5.88		Do......	19	....do	29	—3.66
	Do......	20	....do	29	—5.94		August*....	30	Wolverhampton	1	—0.97
	Do......	20	....do	29	—6.01		Do......	30	....do	4	—1.79
	Do......	20	....do	30	—6.64		Do......	30	....do	11	—1.13
	Do......	20	....do	30	—6.62		Do......	30	....do	13	—0.42
	Do......	20	Cracow	1	—5.31		Do......	30	....do	14	—1.49
	Do......	20	....do	4	—6.48		Do......	30	Greenwich	1	—0.24
	Do......	20	....do	6	—6.78		Do......	30	....do	4	—0.71
	Do......	20	....do	8	—4.72		Do......	30	....do	11	—0.58
	Do......	20	....do	13	—7.70		Do......	30	Brussels	1	—0.16
	Do......	20	....do	11	—5.29		Do......	30	....do	1	—0.47
	Do......	20	....do	14	—6.42		Do......	30	....do	8	—1.42
	Do......	20	Greenwich	11	—2.82		Do......	30	....do	3	+0.36
	March.....	19	Southwick	4	—1.91		Do......	30	....do	11	—0.53
	Do......	19	....do	3	—1.05		Do......	30	....do	4	—1.06
	Do......	19	....do	13	—2.88		Do......	30	....do	13	—0.57
	Do......	19	....do	14	—2.52		Do......	30	....do	13	—0.88
	Do......	19	....do	20	—2.50		Do......	30	....do	13	—0.12
	Do......	19	....do	29	—3.03		Do	30	....do	14	+0.13
	Do......	19	West Haverford	3	—2.49		Do......	30	....do	14	+0.75
	Do......	19	....do	4	—2.53		Do......	30	....do	20	—0.88
	Do......	19	....do	13	—3.63		Do......	30	....do	20	—1.14
	Do......	19	....do	6	—0.74		Do......	30	....do	29	—0.97
	Do......	19	....do	14	—2.19		Do......	30	....do	29	—1.01
	Do......	19	Nantucket	4	—0.87		September .	26	Newark.......	3	—3.70
	Do......	19	....do	14	—2.58		October....	24	Nicolaeff......	34	—1.54
	Do......	19	Williamstown .	4	—1.01		Do......	24	....do	42	—8.28
	Do......	19	....do	3	+0.32	1859	January ...	14	St. Petersburg .	4	—4.18
	Do......	19	....do	13	+0.71		Do......	14	....do	4	—4.61

APPENDIX No. 12—Continued.

Values of Σ_2-p for the period 1857–'61—Continued.

Year.	Month.	Day of month.	Place.	No. of star.	Σ_2-p $=\delta p$.	Year.	Month.	Day of month.	Place.	No. of star.	Σ_2-p $=\delta p$.
					″						″
1859	January	14	St. Petersburg	14	−1.02	1859	October	14	West Point	34	+0.20
	Do	14	do	14	−1.41		Do	14	do	39	−5.72
	Do	14	Vienna	3	−6.09		Do	14	do	44	−2.58
	Do	14	do	4	+0.81		Do	14	do	45	−0.63
	Do	14	do	4	+0.84		December	8	Berlin	37	−3.85
	Do	14	do	4	+0.66		Do	8	do	39	−4.78
	Do	14	do	4	+0.75		Do	8	Greenwich	17	−4.58
	Do	14	do	13	−4.34		Do	8	do	17	−4.24
	Do	14	do	14	−1.43		Do	8	do	17	−4.34
	Do	14	Liverpool	3	−5.46		Do	8	do	34	−1.70
	Do	14	do	4	−1.37		Do	8	do	34	−1.51
	Do	14	do	13	−4.55		Do	8	do	34	−1.36
	Do	14	do	14	−3.74		Do	8	do	42	−4.38
	Do	14	do	29	−4.27		Do	8	do	42	−4.00
	Do	14	do	20	−0.49		Do	8	do	42	−4.15
	April	6	St. Petersburg	1	−3.77		Do	8	do	41	−1.16
	Do	6	do	1	−4.13		Do	8	do	41	−1.11
	Do	6	do	1	−3.99		Do	8	Highbury	34	−1.94
	Do	6	do	4	−4.70		Do	8	do	41	+0.73
	Do	6	do	4	−4.75		Do	8	Forest Lodge	34	−1.51
	Do	6	do	4	−4.81		Do	8	do	42	−3.87
	Do	6	do	11	−3.89		Do	8	Brussels	17	−5.07
	Do	6	do	11	−3.99		Do	8	do	11	−5.09
	Do	6	do	11	−3.68		Do	8	do	11	−5.57
	Do	6	Konisberg	13	−5.02		Do	8	do	27	−1.65
	Do	6	do	13	−5.02		Do	8	do	27	−0.84
	Do	6	do	8	−2.77		Do	8	do	34	−2.26
	Do	6	do	11	−3.02		Do	8	do	34	−2.04
	Do	6	do	11	−2.76		Do	8	do	42	−2.84
	Do	6	do	29	−4.50		Do	8	do	42	−2.87
	Do	6	do	29	−4.39	1860	January	4	Southwick	3	−5.51
	Do	6	do	30	−4.81		Do	4	do	4	+0.13
	Do	6	Breslau	4	−5.02		Do	4	do	13	−4.37
	Do	6	do	3	−2.25		Do	4	do	14	−1.78
	Do	6	do	13	−2.66		Do	4	Greenwich	2	−3.65
	Do	6	do	14	−3.54		Do	4	do	4	−5.90
	Do	6	do	11	+0.44		Do	4	do	11	−8.40
	Do	6	Gottingen	3	+0.02		February	28	do	4	−3.38
	Do	6	do	13	−4.52		Do	28	do	4	−3.46
	Do	6	do	13	−4.40		Do	28	do	1	−1.21
	Do	6	do	14	−2.80		Do	28	do	1	−1.16
	Do	6	do	14	−2.81		Do	28	do	1	−1.10
	Do	6	do	20	−3.59		Do	28	do	13	−6.16
	Do	6	do	29	−3.62		Do	28	do	8	−4.48
	Do	6	do	30	−3.83		Do	28	do	14	−5.83
	September	17	Christiania	1	+1.75		Do	28	do	11	−3.99
	Do	17	do	2	−0.31		Do	28	do	11	−3.92
	Do	17	Nicolaeff	2	+0.13		Do	28	do	11	−3.73
	Do	17	do	1	+0.42		Do	28	Nicolaeff	1	−4.46
	Do	17	do	4	−1.22		Do	28	do	1	−4.21
	Do	17	do	4	−1.41		Do	28	do	4	−5.18
	Do	17	do	13	+0.50		Do	28	do	4	−5.18
	Do	17	do	13	+0.31		Do	28	do	6	−5.66
	Do	17	do	8	−0.89		Do	28	do	8	−5.82
	Do	17	do	11	+0.43		Do	28	do	8	−5.58
	Do	17	do	11	+0.97		Do	28	do	11	−4.62
	Do	17	do	14	−1.34		Do	28	do	11	−4.72
	Do	17	do	15	−0.15		Do	28	do	13	−5.34
	Do	17	do	16	−3.40		Do	28	do	13	−5.03
	Do	17	do	23	−7.26		Do	28	do	14	−5.26
	Do	17	do	18	−0.47		Do	28	do	14	−5.16
	Do	17	do	20	+0.66		Do	28	Highbury	4	−3.94
	Do	17	do	20	+0.36		Do	28	do	1	−1.39
	Do	17	do	37	−0.59		Do	28	do	11	−3.87
	Do	17	do	39	+0.46		Do	28	Liverpool	1	−4.15
	Do	17	do	39	−1.47		Do	28	do	4	−4.04
	Do	17	do	45	+0.07		Do	28	do	6	−4.38
	Do	17	do	44	+0.27		Do	28	do	13	−6.68
	Do	17	do	50	−1.59		Do	28	do	10	−1.88
	Do	17	do	52	+0.55		Do	28	do	20	−4.63
	October	14	Washington	34	+0.27		Do	28	do	30	−4.76
	Do	14	West Point	11	−1.07		Do	28	Cambridge, E.	1	−3.07

APPENDIX No. 12—Continued.

Values of $\Sigma_2 - p$ *for the period* 1857–'61—Continued.

	Month.	Day of month.	Place.	No. of star.	$\Sigma_2 - p = \delta p$.	Year.	Month.	Day of month.	Place.	No. of star.	$\Sigma_2 - p = \delta p$.
					$''$						$''$
1860	February	28	Cambridge, E.	6	−3.27	1860	September	6	Utrecht	26	+0.21
	Do	28	do	9	−5.13		Do	6	do	27	+0.11
	Do	28	do	8	−3.63		Do	6	do	34	−0.07
	Do	28	do	11	−3.50		Do	6	do	34	+0.14
	Do	28	do	14	−5.30		Do	6	do	34	−0.28
	Do	28	do	10	−0.21		Do	6	do	37	−0.15
	Do	28	do	20	−4.86		Do	6	do	39	+0.25
	Do	28	do	29	−5.51		Do	6	do	41	−0.31
	Do	28	do	30	−4.23		Do	6	do	44	+0.34
	Do	28	do	39	−0.14		Do	6	do	42	−1.20
	Do	28	do	45	−1.24		Do	6	do	42	−1.12
	Do	28	do	52	−4.05		Do	6	do	45	−1.32
	March	26	Ross Mountain	13	−6.82		Do	6	do	46	+0.17
	Do	26	do	14	−5.19		Do	6	do	50	−0.89
	Do	26	do	11	−2.41		Do	6	do	52	+0.08
	Do	26	do	20	−7.97		Do	6	Vienna	2	+0.44
	Do	26	do	29	−6.54		Do	6	do	2	+0.29
	Do	26	do	30	−7.97		Do	6	do	5	+0.93
	Do	26	do	44	−0.58		Do	6	do	12	+1.87
	July	13	Newport, Mo.	17	+1.98		Do	6	do	12	+2.21
	Do	13	do	34	−0.77		Do	6	do	17	+2.21
	Do	13	do	39	−0.39		Do	6	do	17	+1.84
	Do	13	do	41	−4.27		Do	6	do	18	+0.24
	Do	13	do	42	+0.48		Do	6	do	21	+0.91
	Do	13	Gunstock	2	+3.56		Do	6	do	27	+2.11
	Do	13	do	17	+4.27		Do	6	do	26	+0.71
	Do	13	do	27	+3.73		Do	6	do	34	+0.53
	Do	13	do	34	+3.47		Do	6	do	34	+0.37
	Do	13	West Point	2	+3.68		Do	6	do	33	+0.90
	Do	13	do	5	+6.65		Do	6	do	42	+1.03
	Do	13	do	7	+5.65		Do	6	do	42	+1.13
	Do	13	do	12	+4.68		Do	6	do	44	+0.69
	Do	13	do	17	+4.04		Do	6	do	44	+0.58
	Do	13	do	15	+4.92		Do	6	do	46	+0.84
	Do	13	do	16	+5.75		Do	6	do	46	+0.27
	Do	13	do	18	+3.03		Do	6	do	45	+1.40
	Do	13	do	21	+4.14		Do	6	do	45	+1.00
	Do	13	do	27	+4.27		Do	6	Dantzic, (II)	2	+0.50
	Do	13	do	26	+4.25		Do	6	do	17	+2.02
	Do	13	do	34	+3.64		Do	6	do	34	+2.15
	Do	13	do	33	+5.02		Do	6	do	42	−0.59
	Do	13	do	37	+3.41		Do	6	Christiania	5	−0.30
	Do	13	do	39	−3.50		Do	6	do	5	−0.20
	Do	13	do	42	+0.22		Do	6	do	5	−0.50
	Do	13	Charleston	2	+4.70		Do	6	do	12	+0.98
	Do	13	do	8	+3.11		Do	6	do	12	+0.94
	Do	13	do	11	−7.74		Do	6	do	12	+1.02
	Do	13	do	17	+3.07		Do	6	do	17	+2.08
	Do	13	do	12	−9.56		Do	6	do	17	+0.97
	Do	13	do	15	+9.29		Do	6	do	31	+0.54
	Do	13	do	16	+10.33		Do	6	do	40	+0.27
	Do	13	do	21	+2.16		Do	6	do	45	−0.98
	Do	13	do	23	−5.69		Do	6	do	41	+0.74
	Do	13	do	27	+3.55		Do	6	do	41	+0.70
	Do	13	do	34	+4.47		Do	6	do	42	+0.76
	Do	13	do	33	+4.55		Do	6	do	42	+0.94
	Do	13	do	42	+0.38		Do	6	do	53	−0.79
	Do	13	do	39	+5.92		Do	6	do	50	+1.02
	September	6	Wilna	2	+0.66		Do	6	Berlin	41	+0.87
	Do	6	do	12	−1.87		Do	6	do	42	−0.94
	Do	6	do	17	+3.28		Do	6	do	45	−0.01
	Do	6	do	17	+3.13		Do	6	do	46	+1.14
	Do	6	do	16	+1.74		Do	6	do	48	+1.34
	Do	6	do	23	+4.31		Do	6	do	49	−0.15
	Do	6	do	34	+3.21		Do	6	do	50	+0.51
	Do	6	do	41	+0.59		Do	6	Greenwich	34	+0.23
	Do	6	do	42	−1.13		Do	6	do	34	+0.48
	Do	6	Utrecht	17	+3.21		Do	6	do	41	−0.19
	Do	6	do	28	−0.30		Do	6	do	41	−0.67
	Do	6	do	31	+0.60		Do	6	do	42	+1.17
	Do	6	do	23	−0.97		Do	6	do	42	+1.38

APPENDIX No. 12—Continued.

Values of Σ_2—p for the period 1857–'61—Continued.

Year.	Month.	Day of month.	Place	No. of star.	$\Sigma_2 - p = \delta p$.	Year.	Month.	Day of month.	Place.	No. of star.	$\Sigma_2 - p = \delta p$.
					″						″
1860	September .	6	Nicolaeff......	2	+1.44	1860	December..	24	West Point ...	53	—3.39
	Do......	6	....do	8	—2.87		Do......	24	New York	5	—7.84
	Do......	6	....do	7	—4.86		Do......	24	....do	12	—6.93
	Do......	6	....do	17	+0.92		Do......	24	....do	16	—6.78
	Do......	6	....do	15	+0.28		Do......	24	....do	18	—5.83
	Do......	6	....do	16	+1.16		Do......	24	....do	34	—6.44
	Do......	6	....do	34	+1.25		Do......	24	....do	31	—3.92
	Do......	6	Nicolaeff, (II).	11	—2.73		Do......	24	....do	33	—5.53
	Do......	6	....do	34	+0.65		Do......	24	....do	39	—4.50
	October ...	3	New York	2	+1.72		Do......	24	....do	42	—6.84
	December..	24	West Point ...	2	—6.67		Do......	24	....do	41	—5.28
	Do......	24	....do	5	—8.46		Do......	24	....do	46	—6.45
	Do......	24	....do	12	—8.12		Do......	24	....do	45	—3.97
	Do......	24	....do	17	—7.40		Do......	24	Southwick	2	—5.90
	Do......	24	....do	15	—5.42		Do......	24	....do	34	—7.56
	Do......	24	....do	16	—6.37		Do......	24	....do	41	—4.65
	Do......	24	....do	18	—5.70		Do......	24	....do	42	—5.84
	Do......	24	....do	23	—7.75		Do......	24	Charleston	2	—6.71
	Do......	24	....do	26	—7.72		Do......	24	....do	1	—6.80
	Do......	24	....do	34	—6.42		Do......	24	....do	11	—6.29
	Do......	24	....do	31	—3.27		Do......	24	....do	34	—6.80
	Do......	24	....do	33	—5.34		Do......	24	....do	42	—4.78
	Do......	24	....do	41	—4.93		Do......	24	....do	41	—0.91
	Do......	24	....do	45	—3.36	1861	February ..	17	Forest Lodge..	17	—6.17
	Do......	24	....do	50	—4.09						

APPENDIX No. 13.

CAMBRIDGE, *November* 22, 1865.

Method of determining the corrections of lunar semidiameter, mean place, ellipticity of orbit, longitude of perihelion, coefficient of annual parallax, and longitude of Europe and America from the occultations of the Pleiades.

1. Find for each night of occultations what may be called, for convenience, the mean instant, (t_0;) and if there are European and American occultations in the same night, find separately the European and American mean instants, excluding from this determination all rejected observations.

Compute the mean instant (t_0) by the formula

$$t_0 = \frac{\Sigma(tb)}{\Sigma b}$$

in which Σ denotes the sum of all the occultations of the night.

t is the interval of time in seconds from any mean epoch.

t_0 is the interval of time for the mean instant.

$b = D_c p$.

2. Find for the mean instant the average value of Σ_2 for the different places of observation, and denote one-thousandth part of this value by a. Find for the same instant the value of f and its hourly variation, which may be denoted by f'; find also $\sin f$ and $\cos f$ and denote

$$a_1 = \sin f$$

$$a_2 = \cos f$$

$$a'_1 = \frac{f' \sin 1^\circ}{3600} \cos f = [4.6856] f' \cos f$$

$$a'_2 = -\frac{f' \sin 1^\circ}{3600} \sin f = -[4.6856] f' \sin f.$$

Find also for this time the argument 39 of Hansen's tables of the fundamental arguments, and with this argument the corresponding number of table 50, which may be denoted by $23750\, a_3$, and the hourly variation of a_3 may be denoted by ($3600\, a'_3$.) Find $D_t l$ and denote it by a_4.

3. Compute $\Sigma(b^2)$ and $\Sigma\left((t-t_0)b\right)^2$ and $\Sigma\left[(t-t_0)\,b^2\right]$, and also $\Sigma\,\delta p$, $\Sigma(b\,\delta p)$ and $\Sigma\left[b\,(t-t_0)\,\delta p.\right]$

4. Denote the number of observations by n and determine the values of (i,j) by the following formulæ which define them, observing that $(i,j)=(j,i)$.

$$(1,1)=n\,a^2$$
$$(1,2)=a\,\Sigma b$$
$$\left(1\,(i+2)\right)=a\,a_i\,\Sigma b$$
$$(2,2)=\Sigma(b^2)$$
$$(2,i+2)=a_i\,\Sigma(b^2)+a'_i\,\Sigma\left((t-t_0)\,b^2\right)$$
$$(i+2,\,i+2)=a^2_i\,\Sigma(b^2)+2\,a_i\,a'_i\,\Sigma\left((t-t_0)\,b^2\right)+a'^2_i\,\Sigma\left((t-t_0)^2\,b^2\right)$$
$$(i+2,j+2)=a_i\,a_j\,\Sigma(b^2)+(a_i a'_j+a_j a'_i)\,\Sigma\left((t-t_0)\,b^2\right)+a'_i a'_j\,\Sigma\left((t-t_0)^2\,b^2\right)$$

in which i and j are both taken as great as unity and it is to be noticed that a'_4 vanishes. Compute also

$$(1,k)=a\,\Sigma\,\delta p$$
$$(2,k)=\Sigma\,(b\,\delta p)$$
$$(i+2,k)=a_i\,\Sigma(b\,\delta p)+a'_i\,\Sigma\left[b\,(t-t_0)\,\delta p\right]$$

the values of (i,j) and (i,k) for whole series of observations are to be added together, and if we denote by S the corresponding summation, we may put

$$[i,j]=S\,(i,j)$$
$$[i,k]=S\,(i,k)$$

the final calculations are then

$$[1,1]\,\delta\sigma+[1,2]\,\delta l+[1,3]\,\delta e+[1,4](-e\,\delta\omega)+[1,5]\,\delta h+[1,6]\,\delta\lambda=[1,k]$$
$$[2,1]\,\delta\sigma+[2,2]\,\delta l+[2,3]\,\delta e+[2,4]\,(-e\,\delta\omega)+[2,5]\,\delta h+[2,6]\,\delta\lambda=[2,k]$$

or, in general,

$$[i,1]\,\delta\sigma+[i,2]\,\delta l+[i,3]\,\delta e+[i,4]\,(-e\,\delta\omega)+[i,5]\,\delta h+[i,6]\,\delta\lambda=[i,k]$$

in which

$\delta\sigma =$ correction of moon's semidiameter.
$\delta l =$ correction of moon's longitude for the mean time of the whole series.
$\delta e =$ correction of ellipticity of lunar orbit.
$\delta\omega =$ correction of longitude of moon's perihelion.
$\delta h =$ correction of coefficient of annual variation.
$\delta\lambda =$ correction of longitude of Europe and America.

These equations are to be solved by the usual manner.

NOTE.—In the first approximation all terms multiplied by $(t-t_0)$ may be rejected.

BENJAMIN PEIRCE.

Example of the preparation of the equations of a night to obtain the final equations.

[Continued from Coast Survey Report of 1861, Appendix No. 17.]

Place.	Star.	No. of obs.	t from Greenw. 5 h.	Log t.	Log b + log (No. of obs.)	Log (bt.)	b.	bt.
			s.					
Greenwich	1	2	1434	3.1565	9.9812	3.1377	.958	1373
	4	1	3411	3.5329	9.9674	3.5003	.928	3164
	11	1	3497	3.5437	9.7464	3.2901	.558	1950
Cambridge	1	1	1574	3.1970	9.7374	2.9344	.546	860
	4	1	3428	3.5350	9.9746	3.5096	.943	3233
	11	1	3602	3.5565	9.7892	3.3457	.615	2217
Ashurst	1	1	1373	3.1377	9.6559	2.7936	.453	622
	4	1	3389	3.5301	9.9652	3.4953	.923	3128
	11	1	3447	3.5374	9.7325	3.2699	.540	1862
Σ	......	10	....	....	....	....	6.464	18409

Place.	Star.	No. of obs.	t from Greenw. 3 h.	Log t.	Log b + log (No. of obs.)	Log (bt.)	b.	bt.
Washington......	2	1	3113	3.4932	9.9185	3.4117	.829	2580
	1	1	3562	3.5516	9.9982	3.5498	.996	3547
	4	1	4142	3.6172	9.9311	3.5483	.853	3534
	11	1	5148	3.7116	9.9976	3.7092	.994	5119
Philadelphia	2	4	3223	3.5083	0.5164	4.0247	3.284	10586
	1	4	3696	3.5677	0.6003	4.1680	3.984	14723
	4	4	4299	3.6334	0.5379	4.1713	3.451	14836
	11	3	5298	3.7241	0.4743	4.1984	2.981	15791
Boston	2	1	3501	3.5442	9.9043	3.4485	.802	2809
	1	1	4021	3.6043	9.9984	3.6027	.996	4006
	4	1	4674	3.6697	9.9450	3.6147	.881	4118
	11	1	5659	3.7527	9.9962	3.7489	.991	5609
Σ	......	23	....	....	....	....	21.042	87258

$t - t_0$.	Log ($t - t_0$.)	Log b ($t - t_0$.)	b ($t - t_0$.)	Log b^2 + log (No. of obs.)	b^2.	Log [$b^2 (t - t_0)$] + log (No. of obs.)	$b^2 (t - t_0$.)
− 1414	3.1504$_n$	3.1316$_n$	−1354	9.6614	.4586	2.8118$_n$	− 648
+ 563	2.7505	2.7179	+ 522	9.9348	.8606	2.6853	+ 485
+ 649	2.8122	2.5586	+ 362	9.4928	.3110	2.3050	+ 202
− 1274	3.1052$_n$	2.8426$_n$	− 696	9.4748	.2984	2.5800$_n$	− 380
+ 580	2.7634	2.7380	+ 547	9.9492	.8896	2.7126	+ 516
+ 754	2.8774	2.6666	+ 464	9.5784	.3788	2.4558	+ 286
− 1475	3.1688$_n$	2.8247$_n$	− 668	9.3118	.2050	2.4806$_n$	− 302
+ 541	2.7332	2.6984	+ 499	9.9304	.8520	2.6636	+ 461
+ 599	2.7774	2.5099	+ 324	9.4650	.2917	2.2424	+ 175
			0		4.5457		795
− 1034	3.0145$_n$	2.9330$_n$	− 857	9.8370	.6870	2.8515$_n$	− 710
− 585	2.7672$_n$	2.7654$_n$	− 583	9.9964	.9918	2.7636$_n$	− 580
− 5	0.6990$_n$	0.6301$_n$	− 4	9.8622	.7282	0.5612$_n$	− 4
+ 1001	3.0004	2.9980	+ 995	9.9952	.9890	2.9956	+ 990
− 924	2.9657$_n$	3.4821$_n$	−3035	0.4308	2.6965	3.3965$_n$	− 2491
− 451	2.6542$_n$	3.2545$_n$	−1797	0.5986	3.9683	3.2528$_n$	− 1790
+ 152	2.1818	2.7197	+ 524	0.4738	2.9771	2.6556	+ 452
+ 1151	3.0611	3.5354	+3431	0.4715	2.9614	3.5326	+ 3408
− 646	2.8102$_n$	2.7145$_n$	− 518	9.8086	.6436	2.6188$_n$	− 416
− 126	2.1004$_n$	2.0988$_n$	− 125	9.9968	.9928	2.0972$_n$	− 125
+ 527	2.7218	2.6668	+ 464	9.8900	.7762	2.6118	+ 409
+ 1512	3.1796	3.1758	+1499	9.9924	.9826	3.1720	+ 1486
			− 6		19.3945		629

Example of the preparation of the equations of a night, &c.—Continued.

Log $[b(t-t_0)]^2$. + log (No. of obs.)	$\frac{1}{100}b^2(t-t_0)^2$.	$\Sigma(\delta p.)$	Log (δp) — log (No. of obs.)	Log $(b\delta p.)$	Log $[(t-t_0)\,b\delta p.]$	$b\delta p.$	$b(t-t_0)\,\delta p.$
5.9622	9166	— .25	9.0969$_n$	9.0781$_n$	2.2285	— .120	+ 169
5.4358	2728	— 2.93	0.4669$_n$	0.4343$_n$	3.1848$_n$	— 2.718	— 1530
5.1172	1310	+ .21	9.3222	9.0686	1.8808	+ .117	+ 76
5.6852	4844	— 1.11	0.0453$_n$	9.7827$_n$	2.8879	— .606	+ 773
5.4760	2992	— 3.87	0.5877$_n$	0.5623$_n$	3.3257$_n$	— 3.650	— 2117
5.3332	2154	— .49	9.6902$_n$	9.4794$_n$	2.3568$_n$	— .302	— 227
5.6494	4461	— .33	9.5185$_n$	9.1744$_n$	2.3432	— .149	+ 220
5.3968	2493	— 4.28	0.6314$_n$	0.5966$_n$	3.3298$_n$	— 3.950	— 2137
5.0198	1047	— .27	9.4314$_n$	9.1639$_n$	1.9413$_n$	— .146	— 87
	31195	—13.32				—11.524	— 4860
5.8660	7345	— 2.32	0.3655$_n$	0.2840$_n$	3.2985	— 1.923	+ 1988
5.5308	3395	— 2.10	0.3222$_n$	0.3204$_n$	3.0876	— 2.092	+ 1224
1.2602	0	— 1.95	0.2900$_n$	0.2211$_n$	0.9201	— 1.664	+ 8
5.9960	9908	— 3.45	0.5378$_n$	0.5354$_n$	3.5358$_n$	— 3.431	— 3434
6.3622	23025	— 3.91	9.9902$_n$	0.5066$_n$	3.4723	— 3.211	+ 2966
5.9070	8075	—14.08	0.5466$_n$	1.1469$_n$	3.8011	—14.024	+ 6325
4.8374	688	—11.60	0.4625$_n$	1.0004$_n$	3.1822$_n$	—10.009	— 1521
6.5937	39237	— 9.09	0.4815$_n$	0.9558$_n$	4.0169$_n$	— 9.032	—10397
5.4290	2685	+ .18	9.2553	9.1596	1.9698$_n$	+ .144	— 93
4.1976	158	— 4.07	0.6096$_n$	0.6080$_n$	2.7084	— 4.055	+ 511
5.3336	2156	— 3.44	0.5366$_n$	0.4816$_n$	3.2034$_n$	— 3.031	— 1597
6.3516	22470	— 3.07	0.4871$_n$	0.4833$_n$	3.6629$_n$	— 3.043	— 4601
	119142	—58.90				—55.371	— 8621

	European.	American.		European.	American.
Log $\Sigma(bt)$	4.26503	4.94081	23750 a_3	46523	46619
Log Σb	0.81050	1.32309	Log (23750 a_3)	4.66767	4.66856
Log t_0	3.45454	3.61772	Log 23750	4.37566	
t_0	2848	4147	Log a_3	0.29201	0.29290
Log a	9.99972	9.99801	(23750) (3600) a'_3	—58	
f	15.°73805	14°75131	Log [(23750) (3600) a'_3]	1.7634$_n$	
	15° 44′ 17″	14° 45′ 05″	Log 23750 + log 3600	7.9320	
f'	0.°60221		Log a'_3	3.8314$_n$	
Log a_1	9.43335	9.40590	Log a_4	9.78416	9.78466
Log a_2	9.98341	9.98544	Log a^2	9.99944	9.99602
Log f'	9.7797		Log n	1.00000	1.36173
Log sin 1° — log 3600	4.6856				
[4.6856] + log f'	4.4653				
Log a'_1	4.4487	4.4507			
Log a'_2	3.8987$_n$	3.8712$_n$			
Arg. 39	1.5970	1.5289			
Log (1, 1)	0.99944	1.35775	(1, 1)	9.987	22.790
Log (1, 2)	0.81022	1.32110	(1, 2)	6.460	20.946
Log (1, 3)	0.24357	0.72700	(1, 3)	1.752	5.333
Log (1, 4)	0.79363	1.30654	(1, 4)	6.218	20.255
Log (1, 5)	1.10223	1.61400	(1, 5)	12.654	41.115
Log (1, 6)		1.10576	(1, 6)		12.757
Log (2, 2)	0.65760	1.28768	(2, 2)	4.546	19.395
Log (2, 3), log a_1 + log $\Sigma b^2 = p_1$	0.09095	0.69358	(2, 3)	1.233	4.938
Log (2, 4), log a_2 + log $\Sigma b^2 = p_2$	0.64101	1.27312	(2, 4)	4.375	18.755
Log (2, 5), log a_3 + log $\Sigma b^2 = p_3$	0.94961	1.58058	(2, 5)	8.905	38.070
Log (2, 6), log a_4 + log $\Sigma b^2 = p_4$		1.07234	(2, 6)		11.812
Log a'_1 + log $\Sigma(t-t_0)\,b^2 = q_1$					
Log a'_2 + log $\Sigma(t-t_0)\,b^2 = q_2$					
Log a'_3 + log $\Sigma(t-t_0)\,b^2 = q_3$					
$p_1 - q_1$					
Log (3, 3)	9.52430	0.09948	(3, 3)	0.334	1.257
Log (3, 4)	0.07436	0.67902	(3, 4)	1.187	4.776
Log (3, 5)	0.38296	0.98648	(3, 5)	2.415	9.693
Log (3, 6)		0.47824	(3, 6)		3.008
Log (4, 4)	0.62442	1.25856	(4, 4)	4.211	18.137
Log (4, 5)	0.93302	1.56602	(4, 5)	8.571	36.815
Log (4, 6)		1.05778	(4, 6)		11.423
Log (5, 5)	1.24162	1.87348	(5, 5)	17.443	74.727
Log (5, 6)		1.36524	(5, 6)		23.187
Log (6, 6)		0.85700	(6, 6)		7.194
Log (1, k)	1.12422$_n$	1.76813$_n$	(1, k)	—13.312	— 58.631
Log (2, k)	1.06160$_n$	1.74328$_n$	(2, k)	—11.524	— 55.371
Log (3, k)	0.49495$_n$	1.14918$_n$	(3, k)	— 3.126	— 14.099
Log (4, k)	1.04501$_n$	1.72872$_n$	(4, k)	—11.092	— 53.545
Log (5, k)	1.35361$_n$	2.03618$_n$	(5, k)	—22.574	—108.688
Log (6, k)		1.52794$_n$	(6, k)		— 33.724

APPENDIX No. 14.

DEAR SIR: I have the pleasure of reporting the following results as attained during the year just elapsed, in addition to other purely routine work:

It having been decided to employ the large transit instrument, the mounting and adjustment of which I mentioned in my last annual report, in the observation of certain zones of stars, the micrometer was turned round 90° to permit the determination of differences of declination. An unexpected difficulty, however, presented itself in the impossibility of obtaining proper illumination for the horizontal threads on a dark field, and, after many trials, it became evident that this could not be obtained without again taking the instrument to pieces and rearranging the prisms of the eye-piece, which were apparently inadequate to the illumination of the horizontal threads. After careful consideration of the judiciousness of this course, it was decided not to destroy the adjustments already made, but to apply the instrument, for a time at least, to other needed investigations which could be prosecuted without the use of the micrometer. Accordingly observations were commenced on the 24th of February, and have been continued to the present time on every clear night but three throughout the year, when the moonlight permitted, with the exception of one month of the summer. During this period four hundred and thirty determinations of right ascensions have been made for forty-four stars situated within one degree of the pole; all of them being invisible to the naked eye. These determinations imply not merely the observation of transits of the stars under investigation, but extensive observations of stars from our standard list for deducing the instrumental corrections. The forty-four polar stars were observed over five transit threads whenever practicable; and an idea of the laborious nature of this work may be derived from the statement that the most rapidly moving of our forty-four stars required ten minutes for the transit across the five threads, which an equatorial star accomplished in as many seconds, while the most slowly moving star requires more than an hour and a quarter for traversing the same. The time required for the remaining forty-two stars is intermediate between the extremes of ten and seventy-seven minutes.

Before the present year shall have elapsed I anticipate that all the stars of the series, with a single exception, will have been observed at both culminations, and very few of them less than three times at either, the average number of observed transits for each star being more than ten.

The reduction of this work has also been vigorously prosecuted, and is already far advanced. The constants for the instrument have been definitely determined, and six or eight weeks will doubtless suffice to complete the computations and present our results in the form of apparent right ascensions as deduced on each night, and of mean right ascensions for the beginning of the year 1865. Six of our stars are not to be found in any catalogue, and the places of less than one-half of them have ever been carefully observed.

In these observations I have been assisted by Mr. Edward Goodfellow until the beginning of May, and since that time by Mr. S. C. Chandler, jr., to each of whom I desire to express my thanks for their valuable and most efficient aid.

The comparison of catalogues for the determination of equinoctial points, to promote the accuracy of results deduced from their combination, has been continued through the year, both in right ascension and declination and results, as affecting declination, finally adopted, and applied to our materials for declinations of standard stars. These declinations may, I think, now claim to vie in accuracy with the right ascensions of our standard lists, and I propose to communicate them, as an appendix to this report. The solution by least squares of so extended a series of equations, each corrected to the same equinoctial points, and affected with an appropriate weight, has been a labor of no small extent. If the results are commensurate in value, they will be a welcome contribution to astronomical science, and of importance in facilitating the determination of latitudes.

Observations published during the year agree in confirming the precision of the right ascensions of both our time star and circumpolar lists, as determined during the last five years, and indicate no need of modification. I have recently been engaged in the redetermination of the right ascensions of the four polars, conformably to the intention expressed a year ago. The results, which are not yet quite completed, but which I hope to communicate in season to be appended to this report, promise a near agreement with my former determination. I may here repeat, what has been already reported to you, that the proper motion of these stars, as published, is that belonging to the epoch of the earliest observations and not to the year 1855, a circumstance which seems to have served as the basis for the sharp criticisms alluded to in my report of a year ago. This blunder, which was probably due to the circumstances under which the computations were originally published, escaped my notice for some time. It would seem, however, too palpable for its real

nature not to be manifest to most astronomers, on the first comparison with proper motions deduced from former investigations; and I have not undertaken to reply to the strictures, although a large edition was printed and distributed to the general public. It seems not to have been remarked that the proper motions of the other three polars were open to the same criticism. The present determinations, including as they do more recent observations, will of course claim precedence.

A considerable amount of time has been given to the investigation of the law of diurnal changes in the azimuth of fixed instruments, which I announced to you in 1861 as established by the experience of many years in our longitude researches, and which seems to be confirmed by the minute examination of the published observations at large observatories. Special computations have been made for the determination of the amount and nature of this change at Greenwich upon those dates for which the published observations permit the scrutiny; but although these researches seem to indicate the existence of such a change there also, the materials hitherto discussed have not been sufficiently copious to afford definite results.

In July last the anticipated establishment of telegraphic communication with Ireland led to thorough and detailed preparation, under the direction of Mr. Hilgard, assistant in charge of office, for the determination of the difference in longitude by methods as far as possible analogous to those employed by us for the measurement of longitudes within the United States. All arrangements were made for the immediate exchange of transatlantic signals, but the misfortune which prevented the establishment of telegraphic communication rendered these preparations nugatory.

Observations in former years having seemed to imply the probable existence of some slight error in the adopted latitude of the Cambridge observatory, an edifice which necessarily serves as a standard point of reference for positions in the vicinity, I instituted in the years 1854–'55 at the Cloverden station a series of observations with the zenith telescope for a more accurate determination of the latitude. The results seemed to confirm my suspicions, as was reported to you unofficially at the time. During the present season I have determined anew the declinations of stars then used, and the observations at Cloverden in 1855 have been reduced anew by Mr. Goodfellow. The results communicated herewith give for the latitude of Cloverden $42^\circ\ 22'\ 40.95''$, with a probable error of $\pm\ 0.075''$; and since this point is by geodetic measurement $7''.20$ south of the Cambridge observatory, we have as the corresponding latitude of the observatory $42^\circ\ 22'\ 48.15''$ or about half a second further south than has been hitherto supposed.

The preparation of our longitude results for publication has continued during the year, and such portions of the computations as have been found susceptible of improvement by the use of more recent data have been revised accordingly. The chain of measurements between the northeastern boundary at Calais, Maine, and the city of New Orleans, has now been carried to a high degree of accuracy, with the exception of some part of the series north of Washington. The determination of the difference of longitude between Washington and New York was never completed telegraphically, but a considerable part of the value yet employed depends upon triangulation across the Hudson. No link of the chain seems so important as this. By telegraphic connection of the original station at New York with the Seaton station and Naval Observatory at Washington southward, and with the Cambridge observatory on the north, our American longitudes will be made to possess a systematic accuracy well worthy of much more labor than they will have cost. And should the policy of completing the circuit of longitude measurements by connecting New Orleans with Washington or New York, by the way of Nashville, St. Louis, and Cincinnati, as recommended in my former reports, be carried out, the series of primary determinations for that portion of our territory lying north of the Gulf and east of the Mississippi might fairly be regarded as complete, and the criterion of final accuracy thus furnished would be of the highest value.

Very respectfully, yours,

B. A. GOULD.

Prof. A. D. BACHE,
Superintendent United States Coast Survey.

APPENDIX No. 15.

CAMBRIDGE, *December*, 1865.

DEAR SIR: I have the pleasure of transmitting a determination of the declinations and proper motions in declination of the stars of our standard time list, the right ascensions having been published in 1862. The declinations for the circumpolar list were published at the same time with the right ascensions, so that both co-ordinates are now determined.

I have also the gratification of stating that a systematic series of observations of the stars of our two lists has for some time been going on, both at the Greenwich and the Washington observatories, so that we may confidently rely upon the means before long of increasing the precision of our determinations. At present there are very few of the 176 stars for which I am able to form any opinion as to the direction in which our value of either co-ordinate deviates from the truth.

These declinations have been determined, like the right ascensions, by means of a full and critical collection of observations, corrected to the standard equinoctial points by formulæ deduced and tables computed for the purpose, and finally discussed by the method of least squares.

They are reduced to the mean equinox of 1855.0, inasmuch as that epoch has been used for the other places of our standard lists. But I hope soon to reduce them all to some later epoch for greater convenience.

Very respectfully, yours,

B. A. GOULD.

Prof. A. D. BACHE,
Superintendent United States Coast Survey.

Declinations of standard time stars.

No.	Name.		δ 1855.0.	μ.	Ann. Prec.	Sec. Var.
			° ′ ″	″	″	″
1	α	Andromedæ	+28 17 23.58	−0.1496	+20.0558	−0.0104
2	γ	Pegasi	+14 22 38.60	+0.0001	20.0496	0.0200
3	α	Cassiopeæ	+55 44 28.92	−0.0425	19.8570	0.0771
4	β	Ceti	−18 46 59.26	+0.0393	19.8048	0.0776
5	ε	Piscium	+ 7 6 30.75	+0.0253	19.4724	0.1171
6	θ′	Ceti	− 8 55 57.64	−0.1926	18.9411	0.1521
7	η	Piscium	+14 35 49.15	+0.0182	18.7323	0.1746
8	ο	Piscium	+ 8 25 34.83	+0.0381	18.2595	0.1981
9	β	Arietis	+20 5 50.87	−0.0941	17.9238	0.2231
10	α	Arietis	+22 46 28.92	−0.1335	17.4122	0 2500
11	65	Ceti	+ 8 9 51.83	−0.0109	17.1316	0.2479
12	γ	Ceti	+ 2 37 20.40	−0.1531	15.5980	0.2919
13	α	Ceti	+ 3 31 5.25	−0.0893	14.5057	0.3214
14	ζ	Arietis	+20 30 14.67	−0.0570	13.7692	0.3702
15	α	Persei	+49 20 26.94	−0.0428	13.2900	0.4686
16	δ	Persei	+47 19 9.47	−0.0500	12.0268	0.4992
17	η	Tauri	+23 39 11.06	−0.0476	11.5844	0.4276
18	ζ	Persei	+31 26 56.44	−0.0240	11.1405	0.4598
19	γ′	Eridani	−13 55 25.84	−0.0885	10.6825	0.3492
20	γ	Tauri	+15 16 25.24	−0.0022	9.1406	0.4449
21	ε	Tauri	+18 51 17.50	−0.0076	8.4638	0.4646
22		Aldebaran	+16 12 49.84	−0.1662	7.8683	0.4635
23	ι	Aurigæ	+32 55 54.73	−0.0123	6.2346	0.5426
24	11	Orionis	+15 11 52.87	−0.0106	5.5040	0.4822
25		Capella	+45 50 41.84	−0.4243	4.6833	0.6275
26		Rigel	− 8 22 21.67	+0.0004	4.5482	0.4111
27	β	Tauri	+28 28 48.71	−0.1731	3.7298	0.5440
28	δ	Orionis	− 0 24 37.28	−0.0096	3.0855	0.4427
29	α	Leporis	−17 55 45.62	+0.0261	2.9354	0.3827
30	ε	Orionis	− 1 17 54.02	+0.0041	2.7170	0.4407
31	α	Columbæ	−34 9 13.84	−0.0217	2.2355	0.3155
32	α	Orionis	+ 7 22 33.36	+0.0175	+ 1.1089	−0.4730

Declinations of standard time stars—Continued.

No.	Name.	δ 1855.0.	μ.	Ann. Prec.	Sec. Var.
		° ′ ″	″	″	″
33	μ Geminorum . . .	+22 35 0.81	—0.1071	—1.2408	—0.5274
34	γ Geminorum . . .	+16 31 7.82	—0.0273	2.5601	0.5002
35	Sirius	. . . . .	. . . .	3.3755	0.3795
36	ε Can. Maj. . . .	—28 46 39.24	+0.0036	4.5907	0.3327
37	δ Can. Maj. . . .	—26 09 56.27	+0.0374	5.4016	0.3403
38	δ Geminorum . . .	+22 14 42.42	+0.0092	6.1527	0.4960
39	α² Geminorum . . .	. . . . .	. . . .	7.2963	0.5223
40	Procyon	. . . . .	. . . .	7.8130	0.4217
41	β Geminorum . . .	+28 22 20.67	—0.0429	8.1924	0.4932
42	φ Geminorum . . .	+27 8 13.12	—0.0140	8.8405	0.4789
43	15 Argus	—23 53 20.01	+0.0727	10.1316	0.3180
44	ε Hydræ	+ 6 56 52.52	—0.0221	12.8309	0.3529
45	ι Ursæ Majoris . .	+48 36 26.55	—0.2657	13.5016	0.4465
46	κ Cancri	+11 14 56.54	+0.0207	14.1750	0.3303
47	α Hydræ	— 8 1 56.03	+0.0442	15.3897	0.2694
48	θ Ursæ Majoris . .	+52 20 6.88	—0.5552	15.5386	0.3776
49	ε Leonis	+24 26 23.01	—0.0060	16.3082	0.2838
50	μ Leonis	+26 41 15.65	—0.0460	16.6520	0.2730
51	Regulus	+12 40 27.36	+0.0215	17.3971	0.2263
52	γ′ Leonis	+20 34 24.27	—0.1187	17.8689	0.2110
53	ρ Leonis	+10 3 5.01	+0.0014	18.3636	0.1778
54	l Leonis	+11 18 41.18	—0.0007	18.8948	0.1465
55	α Ursæ Majoris . .	+62 31 57.54	—0.0826	19.2484	0.1472
56	δ Leonis	+21 19 3.39	—0.1250	19.5098	0.0995
57	δ Crateris	—13 59 39.08	+0.1958	19.6194	0.0824
58	τ Leonis	+ 3 39 16.00	—0.0087	19.7585	0.0687
59	91 Leonis	— 0 1 24.25	+0.0529	19.8789	0.0508
60	β Leonis	+15 22 57.60	—0.0924	19.9918	0.0276
61	γ Ursæ Majoris . .	+54 30 3.37	+0.0024	20.0195	—0.0194
62	ο Virginis	+ 9 32 19.22	+0.0500	20.0550	+0.0044
63	η Virginis	+ 0 8 22.33	—0.0124	20.0262	0.0330
64	β Corvi	—22 35 38.08	—0.0372	19.9192	0.0619
65	12 Canum Ven. . .	+39 6 8.76	+0.0654	19.5949	0.0968
66	θ Virginis	— 4 45 48.77	—0.0204	19.3161	0.1301
67	Spica	—10 24 10.18	—0.0186	18.9184	0.1608
68	ζ Virginis	+ 0 8 49.91	+0.0678	18.6181	0.1745
69	η Ursæ Majoris . .	+50 2 18.25	—0.0215	18.1089	0.1574
70	η Bootis	+19 7 35.42	—0.3332	17.8787	0.1968
71	Arcturus	+19 56 22.14	—1.9640	16.9596	0.2263
72	θ Bootis	+52 31 21.54	—0.3953	16.4160	0.1805
73	ε Bootis	+27 41 16.42	+0.0300	15.4392	0.2509
74	α² Libræ	—15 26 9.98	—0.0561	15.2014	0.3217
75	β Bootis	+40 57 52.87	—0.0390	14.3975	0.2361
76	β Libræ	— 8 50 40.12	—0.0041	13.6005	0.3515
77	μ′ Bootis	+37 53 16.94	+0.0993	12.9578	0.2591
78	α Coronæ Bor. . .	+27 12 19.79	—0.0750	12.3097	0.2966
79	α Serpentis . . .	+ 6 53 6.41	—0.0598	11.7085	0.3533
80	ε Serpentis . . .	+ 4 55 2.85	+0.0801	11.2450	0.3643
81	ε Coronæ Bor. . .	+27 18 2.56	—0.0336	10.6587	0.3119
82	δ Scorpii	—22 12 16.69	+0.0018	10.6453	0.4415
83	δ Ophiuchi . . .	— 3 19 1.58	—0.1277	9.5121	0.4073
84	τ Herculis	+46 39 38.94	+0.0263	8.8405	0.2395
85	Antares	—26 6 20.34	—0.0244	8.4344	0.4888
86	ζ Ophiuchi . . .	—10 16 8.91	+0.0468	7.7415	0.4467
87	η Herculis	+39 12 2.66	—0.0641	7.0298	0.2831
88	κ Ophiuchi . . .	+ 9 36 14.92	+0.0227	5.9636	0.4003
89	d Herculis	+33 46 52.13	+0.0315	5.5069	0.3126
90	a′ Herculis	+14 33 33.27	+0.0472	4.5085	0.3904
91	b Ophiuchi . . .	—24 2 12.23	—0.0853	3.6965	0.5260
92	a Ophiuchi . . .	+12 40 9.49	—0.2143	—2.7735	+0.4019

Declinations of standard time stars—Continued.

No.	Name.	δ 1855.0.	μ.	Ann. Prec.	Sec. Var.
		° ′ ″	″	″	″
93	μ Herculis	+27 48 31.05	−0.7234	− 1.6794	+0.3450
94	γ^2 Sagittarii	−30 25 14.30	−0.2202	− 0.3062	0.5626
95	μ Sagittarii	−21 5 30.99	+0.0026	+ 0.4456	0.5229
96	η Serpentis	− 2 55 56.23	−0.6698	1.2079	0.4566
97	1 Aquilæ	− 8 20 27.73	−0.3095	2.3848	0.4720
98	Vega	+38 39 4.50	+0.2839	2.7938	0.2895
99	β Lyræ	+33 11 49.58	−0.0125	3.8893	0.3150
100	σ Sagittarii	−26 28 18.13	−0.0621	4.0220	0.5304
101	ζ Aquilæ	+13 39 5.38	−0.0855	5.0847	0.3869
102	d Sagittarii	−19 12 21.57	+0.0401	5.9599	0.4872
103	δ Aquilæ	+ 2 49 46.05	+0.0934	6.7103	0.4108
104	κ Aquilæ	− 7 20 44.48	+0.0218	7.6011	0.4328
105	γ Aquilæ	+10 15 47.66	+0.0064	8.4257	0.3739
106	Altair	+ 8 29 19.71	+0.3804	8.7689	0.3756
107	β Aquilæ	+ 6 2 52.74	−0.4704	9.1201	0.3787
108	τ Aquilæ	+ 6 52 19.69	+0.0194	9.8040	0.3687
109	α^2 Capricorni	−12 59 26.33	+0.0137	10.7765	0.4052
110	π Capricorni	−18 40 59.31	−0.0297	11.4330	0.4076
111	ε Delphini	+10 48 48.34	−0.0197	11.9498	0.3307
112	α Cygni	+44 45 50.71	−0.0041	12.6549	0.2257
113	μ Aquarii	− 9 31 26.64	−0.0198	13.2126	0.3499
114	ν Cygni	+40 36 39.84	+0.0128	13.6634	0.2325
115	61′ Cygni	. . . . .	. . . .	14.2067	0.2738
116	ζ Cygni	+29 38 3.74	−0.0564	14.5941	0.2488
117	1 Pegasi	+19 11 11.71	+0.0869	15.1009	0.2590
118	β Aquarii	− 6 12 23.05	+0.0077	15.5821	0.2838
119	ξ Aquarii	− 8 30 6.95	−0.0167	15.9129	0.2767
120	ε Pegasi	+ 9 12 44.78	+0.0082	16.2801	0.2439
121	μ Capricorni	−14 13 54.17	+0.0312	16.6947	0.2563
122	α Aquarii	− 1 1 20.26	−0.0042	17.2956	0.2203
123	θ Aquarii	− 8 30 12.39	−0.0111	17.7566	0.2070
124	π Aquarii	+ 0 38 35.74	+0.0025	18.0974	0.1849
125	η Aquarii	− 0 51 48.02	−0.0499	18.4583	0.1677
126	ζ Pegasi	+10 4 33.17	+0.0068	18.6678	0.1511
127	λ Aquarii	− 8 20 59.30	+0.0526	18.9929	0.1387
128	α Piscis Aust.	−30 23 21.74	−0.1556	19.1179	0.1376
129	α Pegasi	+14 25 34.18	−0.0206	19.3157	0.1086
130	θ Piscium	+ 5 34 59.85	−0.0261	19.7605	0.0676
131	ι Piscium	+ 4 50 27.26	−0.4355	19.9117	0.0448
132	ω Piscium	+ 6 3 38.50	−0.1020	+20.0433	+0.0072

APPENDIX No. 16.

CAMBRIDGE, *November*, 1865.

DEAR SIR: I have recently completed the determination of the positions and proper motions of the four polar stars, α, δ, and λ, Ursæ Minoris and 51 (Hev.) Cephei, which had not been recomputed, like the other forty-four circumpolars, at the time of the publication of the standard lists in 1862.

The resultant values are as follows, the mean places being referred to the equinox of 1855.0:

	α.	μ.	δ.	μ.
	h m s s	s s	° ′ ″ ″	″
α Ursæ Minoris . . .	1 6 30.84 ± 0.22	+ 0.1148 ± 0.0069	88 32 11.08 ± 0.21	+ 0.0042 ± 0.0076
51 (Hev.) Cephei . . .	6 31 5.87 ± 0.06	− 0.1717 ± 0.0025	87 15 8.40 ± 0.43	− 0.0478 ± 0.0274
δ Ursæ Minoris . . .	18 19 6.81 ± 0.01	+ 0.0291 ± 0.0005	86 35 58.76 ± 0.04	+ 0.0430 ± 0.0014
λ Ursæ Minoris . . .	20 8 31.07 ± 0.07	− 0.0617 ± 0.0025	88 52 31.82 ± 0.04	+ 0.0022 ± 0.0015

Appended is an ephemeris of the mean places of these four stars, from the date of the earliest modern observations to the year 1870. The probable errors will indicate the degree of reliance to be placed upon the determinations. It should, however, be mentioned that the earlier observations of 51 Cephei were found so discordant that a merely nominal weight has been assigned to those made prior to 1815.

Very respectfully and truly yours,

B. A. GOULD.

Prof. A. D. BACHE,
Superintendent United States Coast Survey.

α Ursæ Minoris.

Date.	Right ascension. h.	m.	s.	Diff. m. s.	Declination. °	′	″	Diff. ′ ″
1750	0	42	50.739	0 51.373	87	58	2.432	1 38.567
1755		43	42.112	0 52.580		59	40.999	1 38.492
1760		44	34.692	0 53.839	88	01	19.491	1 38.414
1765		45	28.531	0 55.152		2	57.905	1 38.333
1770		46	23.683	0 56.519		4	36.238	1 38.248
1775		47	20.202	0 57.944		6	14.486	1 38.160
1780		48	18.146	0 59.432		7	52.646	1 38.068
1785		49	17.578	1 0.986		9	30.714	1 37.971
1790		50	18.564	1 2.608		11	8.685	1 37.870
1795		51	21.172	1 4.304		12	46.555	1 37.765
1800		52	25.476	1 6.077		14	24.320	1 37.654
1805		53	31.553	1 7.934		16	1.974	1 37.538
1810		54	39.487	1 9.877		17	39.512	1 37.417
1815		55	49.364			19	16.929	
1817		56	17.879	14.382		19	55.861	19.458
1818			32.261	14.466		20	15.319	19.452
1819			46.727	14.551		20	34.771	19.448
1820		57	1.278	14.635		20	54.219	19.442
1821			15.913	14.722		21	13.661	19.436
1822			30.635	14.809		21	33.097	19.431
1823			45.444	14.897		21	52.528	19.426
1824		58	0.341	14.985		22	11.954	19.420
1825			15.326	15.075		22	31.374	19.414
1826			30.401	15.166		22	50.788	19.409
1827			45.567	15.257		23	10.197	19.403
1828		59	0.824	15.349		23	29.600	19.397
1829			16.173	15.442		23	48.997	19.392
1830			31.615	15.537		24	8.389	19.386
1831	0	59	47.152	15.631		24	27.775	19.379
1832	1	0	2.783	15.727		24	47.154	19.373
1833			18.510	15.824		25	6.527	19.368
1834			34.334	15.922		25	25.895	19.361
1835			50.256	16.021		25	45.256	19.355
1836		1	6.277	16.120		26	4.611	19.348
1837			22.397	16.222		26	23.959	19.343
1838			38.619	16.323		26	43.302	19.336
1839			54.942	16.426		27	2.638	19.329
1840		2	11.368	16.530		27	21.967	19.323
1841			27.898	16.635		27	41.290	19.316
1842			44.533	16.741		28	0.606	19.310
1843		3	1.274	16.848		28	19.916	19.303
1844			18.122	16.956		28	39.219	19.295
1845			35.078	17.065		28	58.514	19.289
1846			52.143	17.176		29	17.803	19.282
1847		4	9.319	17.288		29	37.085	19.276
1848			26.607	17.400		29	56.361	19.267
1849			44.007	17.514		30	15.628	19.261
1850		5	1.521	17.629		30	34.889	19.253
1851			19.150	17.745		30	54.142	19.246
1852			36.895	17.863		31	13.388	19.238
1853			54.758	17.982		31	32.626	19.231
1854		6	12.740	18.102		31	51.857	19.224
1855			30.842	18.223		32	11.081	19.215
1856			49.065	18.345		32	30.296	19.208
1857		7	7.410	18.470		32	49.504	19.200
1858			25.880	18.594		33	8.704	19.192
1859			44.474	18.721		33	27.896	19.184
1860		8	3.195	18.849		33	47.080	19.176
1861			22.044	18.979		34	6.256	19.167
1862			41.023	19.108		34	25.423	19.160
1863		9	0.131	19.241		34	44.583	19.151
1864			19.372	19.375		35	3.734	19.142
1865			38.747	19.509		35	22.876	19.134
1866			58.256	19.646		35	42.010	19.125
1867		10	17.902	19.784		36	1.135	19.116
1868			37.686	19.923		36	20.251	19.107
1869			57.609	20.064		36	39.358	19.099
1870	1	11	17.673		88	36	58.457	

51 *Cephei.*

Year.	α.	Diff.	δ.	Diff.
	h. m. s.	m. s.	° ′ ″	″
1790	5 57 34.450	2 35.504	87 16 33.593	+ 0.197
1795	6 0 9.954	2 35.497	16 33.790	− 0.933
1800	2 45.451	2 35.458	16 32.857	2.063
1805	5 20.909	2 35.384	16 30.794	3.192
1810	7 56.293	2 35.275	16 27.602	4.319
1815	10 31.568		16 23.283	
1817	11 33.640	31.027	16 21.240	1.089
1818	12 4.667	31.020	16 20.151	1.134
1819	12 35.687	31.014	16 19.017	1.179
1820	13 6.701	31.007	16 17.838	1.224
1821	13 37.708	30.999	16 16.614	1.269
1822	14 8.707	30.991	16 15.345	1 314
1823	14 39.698	30.984	16 14.031	1.359
1824	15 10.682	30.976	16 12.672	1.404
1825	15 41.658	30.968	16 11.268	1.448
1826	16 12.626	30.958	16 9.820	1.493
1827	16 43.584	30.950	16 8.327	1.538
1828	17 14.534	30.941	16 6.789	1.583
1829	17 45.475	30.932	16 5.206	1.628
1830	18 16.407	30.922	16 3.578	1.673
1831	18 47.329	30.912	16 1.905	1.717
1832	19 18.241	30.901	16 0.188	1.762
1833	19 49.142	30.891	15 58.426	1.807
1834	20 20.033	30.881	15 56.619	1.851
1835	20 50.914	30.869	15 54.768	1.896
1836	21 21.783	30.858	15 52.872	1.941
1837	21 52.641	30.847	15 50.931	1.985
1838	22 23.488	30.835	15 48.946	2.030
1839	22 54.323	30.823	15 46.916	2.075
1840	23 25.146	30.810	15 44.841	2.119
1841	23 55.956	30.798	15 42.722	2.163
1842	24 26.754	30.786	15 40.559	2.208
1843	24 57.540	30.772	15 38.351	2.252
1844	25 28.312	30.759	15 36.099	2.297
1845	25 59.071	30.746	15 33.802	2.341
1846	26 29.817	30.732	15 31.461	2.386
1847	27 0.549	30.717	15 29.075	2.430
1848	27 31.266	30.703	15 26.645	2.474
1849	28 1.969	30.689	15 24.171	2.518
1850	28 32.658	30.674	15 21.653	2.562
1851	29 3.332	30.659	15 19.091	2.607
1852	29 33.991	30.644	15 16.484	2.651
1853	30 4.635	30.628	15 13.833	2.695
1854	30 35.263	30.613	15 11.138	2.739
1855	31 5.876	30.596	15 8.399	2.783
1856	31 36.472	30.580	15 5.616	2.827
1857	32 7.052	30.563	15 2.789	2.871
1858	32 37.615	30.546	14 59.918	2.915
1859	33 8.161	30.529	14 57.003	2.959
1860	33 38.690	30.512	14 54.044	3.002
1861	34 9.202	30.495	14 51.042	3.046
1862	34 39.697	30.477	14 47.996	3.090
1863	35 10.174	30.459	14 44.906	3.134
1864	35 40.633	30.441	14 41.772	3.178
1865	36 11.074	30.422	14 38.594	3.221
1866	36 41.496	30.404	14 35.373	3.265
1867	37 11.900	30.385	14 32.108	3.308
1868	37 42.285	30.365	14 28.800	3.352
1869	38 12.650	+ 30.346	14 25.448	− 3.395
1870	6 38 42.996		87 14 22.053	

δ Ursæ Minoris.

Date.	Right ascension.	Diff.	Declination.	Diff.
	h. m. s.	m. s.	° ′ ″	″
1750	18 52 7.301	—1 31.423	+86 30 27.347	+ 22.481
1755	50 35.878	1 31.773	30 49.828	21.830
1760	49 4.105	1 32.114	31 11.658	21.176
1765	47 31.991	1 32.445	31 32.834	20.519
1770	45 59.546	1 32.761	31 53.353	19.858
1775	44 26.785	1 33.085	32 13.211	19.194
1780	42 53.700	1 33.382	32 32.405	18.527
1785	41 20.318	1 33.675	32 50.932	17.856
1790	39 46.643	1 33.960	33 8.788	17.184
1795	38 12.683	1 34.232	33 25.972	16.508
1800	36 38.451	1 34.497	33 42.480	15.828
1805	35 3.954	1 34.750	33 58.308	15.148
1810	33 29.204	—1 34.993	34 13.456	14.464
1815	31 54.211		34 27.920	
		s.		
1817	31 16.148	— 19.045	34 33.513	2.756
1818	30 57.103	19.054	34 36.269	2.728
1819	30 38.049	19.064	34 38.997	2.700
1820	30 18.985	19.072	34 41.697	2.674
1821	29 59.913	19.081	34 44.371	2.645
1822	29 40.832	19.090	34 47.016	2.618
1823	29 21.742	19.098	34 49.634	2.590
1824	29 2.644	19.106	34 52.224	2.563
1825	28 43.538	19.115	34 54.787	2.535
1826	28 24.423	19.123	34 57.322	2.508
1827	28 5.300	19.132	34 59.830	2.480
1828	27 46.168	19.140	35 2.310	2.452
1829	27 27.028	19.149	35 4.762	2.424
1830	27 7.879	19.157	35 7.186	2.397
1831	26 48.722	19.163	35 9.583	2.369
1832	26 29.559	19.172	35 11.952	2.342
1833	26 10.387	19.180	35 14.294	2.314
1834	25 51.207	19.187	35 16.608	2.285
1835	25 32.020	19.194	35 18.893	2.257
1836	25 12.826	19.202	35 21.150	2.230
1837	24 53.624	19.209	35 23.380	2.203
1838	24 34.415	19.217	35 25.583	2.175
1839	24 15.198	19.225	35 27.758	2.148
1840	23 55.973	19.232	35 29.906	2.121
1841	23 36.741	19.238	35 32.027	2.092
1842	23 17.503	19.245	35 34.119	2.063
1843	22 58.258	19.251	35 36.182	2.034
1844	22 39.007	19.259	35 38.216	2.006
1845	22 19.748	19.265	35 40.222	1.978
1846	22 0.483	19.271	35 42.200	1.951
1847	21 41.212	19.278	35 44.151	1.923
1848	21 21.934	19.285	35 46.074	1.897
1849	21 2.649	19.291	35 47.971	1.869
1850	20 43.358	19.298	35 49.840	1.842
1851	20 24.060	19.304	35 51.682	1.813
1852	20 4.756	19.309	35 53.495	1.784
1853	19 45.447	19.315	35 55.279	1.755
1854	19 26.132	19.320	35 57.034	1.725
1855	19 6.812	19.326	35 58.759	1.698
1856	18 47.486	19.332	36 0.457	1.671
1857	18 28.154	19.338	36 2.128	1.644
1858	18 8.816	19.343	36 3.772	1.616
1859	17 49.473	19.350	36 5.388	1.589
1860	17 30.123	19.354	36 6.977	1.561
1861	17 10.769	19.359	36 8.538	1.532
1862	16 51.410	19.365	36 10.070	1.503
1863	16 32.045	19.369	36 11.573	1.474
1864	16 12.676	19.373	36 13.047	1.445
1865	15 53.303	19.378	36 14.492	1.417
1866	15 33.925	19.383	36 15.909	1.389
1867	15 14.542	19.388	36 17.298	1.362
1868	14 55.154	19.392	36 18.660	1.336
1869	14 35.762	— 19.398	36 19.996	1.307
1870	18 14 16.364		86 36 21.303	

λ Ursæ Minoris.

Year.	α.			Diff.		δ.			Diff.	
	h.	m.	s.	m.	s.	°	′	″	′	″
1750	21	20	9.561	2	29.432	88	29	6.887	+ 1	16.612
1755		17	40.129	2	33.950		30	23.499	1	15.891
1760		15	6.179	2	38.623		31	39.390	1	15.637
1765		12	27.556	2	43.443		32	55.027	1	13.849
1770		9	44.113	2	48.430		34	8.876	1	13.527
1775		6	55.683	2	53.575		35	22.403	1	12.668
1780		4	2.108	2	58.882		36	35.071	1	11.772
1785	21	1	3.226	3	4.354		37	46.843	1	10.836
1790	20	57	58.872	3	9.993		38	57.679	1	9.858
1795		54	48.879	3	15.797		40	7.537	1	8.837
1800		51	33.082	3	21.772		41	16.374	1	7.770
1805		48	11.310	3	27.903		42	24.144	1	6.656
1810		44	43.407	3	34.209		43	30.800	1	5.493
1815		41	9.198				44	36.293		
1817		39	41.720		44.132		45	2.149		12.857
1818		38	57.588		44.394		45	15.006		12.809
1819		38	13.194		44.657		45	27.815		12.758
1820		37	28.537		44.921		45	40.573		12.704
1821		36	43.616		45.188		45	53.277		12.652
1822		35	58.428		45.454		46	5.929		12.602
1823		35	12.974		45.723		46	18.531		12.549
1824		34	27.251		45.992		46	31.080		12.499
1825		33	41.259		46.262		46	43.579		12.445
1826		32	54.997		46.535		46	56.024		12.394
1827		32	8.462		46.806		47	8.418		12.339
1828		31	21.656		47.081		47	20.757		12.287
1829		30	34.575		47.356		47	33.044		12.231
1830		29	47.219		47.632		47	45.275		12.173
1831		28	59.587		47.909		47	57.448		12.116
1832		28	11.678		48.187		48	9.564		12.062
1833		27	23.491		48.467		48	21.626		12.005
1834		26	35.024		48.747		48	33.631		11.948
1835		25	46.277		49.028		48	45.579		11.892
1836		24	57.249		49.311		48	57.471		11.836
1837		24	7.938		49.594		49	9.305		11.775
1838		23	18.344		49.879		49	21.080		11.718
1839		22	28.465		50.163		49	32.798		11.658
1840		21	38.302		50.449		49	44.456		11.594
1841		20	47.853		50.736		49	56.050		11.534
1842		19	57.117		51.026		50	7.584		11.474
1843		19	6.091		51.313		50	19.058		11.412
1844		18	14.778		51.601		50	30.470		11.351
1845		17	23.177		51.894		50	41.821		11.289
1846		16	31.283		52.181		50	53.110		11.226
1847		15	39.102		52.478		51	4.336		11.163
1848		14	46.624		52.767		51	15.499		11.100
1849		13	53.857		53.061		51	26.599		11.035
1850		13	0.796		53.354		51	37.634		10.967
1851		12	7.442		53.649		51	48.601		10.902
1852		11	13.793		53.945		51	59.503		10.835
1853		10	19.848		54.239		52	10.338		10.769
1854		9	25.609		54.535		52	21.107		10.703
1855		8	31.074		54.832		52	31.810		10.635
1856		7	36.242		55.128		52	42.445		10.567
1857		6	41.114		55.420		52	53.012		10.498
1858		5	45.694		55.731		53	3.510		10.430
1859		4	49.963		56.022		53	13.940		10.360
1860		3	53.941		56.320		53	24.300		10.287
1861		2	57.621		56.619		53	34.587		10.216
1862		2	1.002		56.932		53	44.803		10.145
1863		1	4.070		57.202		53	54.948		10.072
1864	20	0	6.868		57.516		54	5.020		10.001
1865	19	59	9.352		57.816		54	15.021		9.928
1866		58	11.536		58.127		54	24.949		9.854
1867		57	13.409		58.401		54	34.803		9.779
1868		56	15.008		58.713		54	44.582		9.706
1869		55	16.295	—	59.012		54	54.288	+	9.632
1870	19	54	17.283			88	55	3.920		

APPENDIX No. 17.

CAMBRIDGE, *November*, 1865.

DEAR SIR: I beg leave to submit the following report upon the latitude of the Cloverden station in Cambridge.

The present series of observations for determining the latitude of the Cloverden station of the Coast Survey at Cambridge were made during the months of August, September, and October, 1855, with the Würdemann telescope, No. 5. Soon after their commencement I was suddenly called away, and the observations were continued by Messrs. James Searles and C. H. F. Peters. Various circumstances have interfered with their complete reduction, the anticipated need for which has not occurred, and during the spring of the present year they have been carefully computed by Mr. Edward Goodfellow.

The stars were selected by me with the view to a careful special investigation of their declinations—and the want of this has been one of the chief reasons for the long delay—but the absence of anticipated facilities has seriously interfered with the original plan. I have, however, made the best determination in my power from the catalogue places, and have so arranged the results that any future emendation of the declinations now adopted may be readily applied to the values now given.

The stars are 38 in number, forming 19 pairs, the differences of whose zenith distances were micrometrically observed by Talcott's method, according to the ordinary practice of the Coast Survey. In all 308 double observations were made, giving an average of about 17 observations to each pair.

For the angular values of a micrometer revolution, observations of Polaris at elongation on six nights yielded the following results:

Date.	No. obs.	Value.	Mean error.
1855.		$''$	$''$
September 19	28	41.398	±0.009
20	27	.352	.018
24	25	.439	.029
25	25	.290	.027
26	25	.318	.031
27	26	.253	±0.022

whence the adopted value 41″.369, with a probable error of 0″.023.

For the value of the level divisions three series of measurements gave the following results:

	r.		$''$
A, by short steps, 10 observations	2.145	=	0.8874
B, with long bubble, — observations....	1.979	=	0.8187
C, with shorter bubble, 10 observations..	2.192	=	0.9068

and assigning only one-half weight to the second result we have the adopted value of one division as 0.88, agreeing well with previous determinations for the same level.

A minute reduction of the observations gives the following results for the quantities to be applied to the half sum of the mean declinations of the several pairs in order to obtain the latitude:

I.	II.	III.	IV.	V.	VI.	VII.
P. XVIII 170, 8 ν Lyræ.	Groombr. 2699, 15 λ Lyræ.	Groombr. 2891, Groombr. 2925.	Groombr. 2992, Bradley 2559.	17 Vulpeculæ, 66 Draconis.	42 Cygni, 46 ω^3 Cygni.	Groombr. 3248, α Cygni.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
+1 24.60	+0 38.85	—1 38.62	—2 35.13	—0 34.23	+1 31.44	—2 19.14
24.42	40.93	38.06	30.83	35.19	29.36	20.68
23.08	38.22	40.42	33.65	34.72	29.62	18.93
21.68	38.20	37.17	32.62	33.85	31.35	17.71
23.68	38.31	36.00	32.80	34.72	32.03	19.24
24.26	38.73	36.85	32.31	33.17	32.12	18.95
25.10	37.27	38.92	37.07	35.47	31.07	19.09
23.73	35.75	39.06	38.82	33.88	29.03	19.19
24.17	37.33	38.76	33.35	(38.88)	28.47	18.54
(26.22)	37.47	38.61	33.08	32.90	30.10	18.94
22.33	37.28	37.88	31.72	34.12	29.77	18.56
24.27	38.64	38.12	33.03	34.90	30.92	17.86
23.70	40.42	37.71	32.87	35.58	30.26	18.83
23.44	37.82	38.25	32.30	35.05	31.12	18.96
24.05	38.01	36.87	29.74	33.74	29.38	18.98
23.02	38.85	37.26	31.49	35.43	30.82	18.88
23.46	38.39	37.99	32.13	34.63	30.03	18.12
23.83	38.61	37.71	31.72	34.66	29.93	18.30
23.58	37.95	....	....	34.85	30.33	18.87
....	37.97	....	....	34.40	30.96	....
....	....	....	....	33.79	29.57	....
....	....	....	....	33.56	....	....
+1 23.69	+0 38.25	—1 38.02	—2 33.04	—0 34.43	+1 30.37	—2 18.83

VIII.	IX.	X.	XI.	XII.	XIII.
30 Vulpeculæ, Groombr. 3274.	Groombr. 3284, Groombr. 3357.	64 ζ Cygni, P. XXI, 86.	Groombr. 3441, 69 Cygni.	73 ρ Cygni, 74 Cygni.	1 Hev. Lacertæ, 2 Lacertæ.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
—2 20.80	+0 39.21	—2 3.42	—1 41.91	+1 10.10	—1 27.22
21.11	37.69	4.19	40.62	10.11	27.77
19.71	38.42	2.69	39.64	11.81	28.42
20.27	38.19	2.95	41.83	10.13	28.77
20.25	36.99	6 68	42.53	10.92	27.55
20.82	34.69	4.11	41.15	12.31	27.32
19.67	(31.83)	3.48	40.49	11.80	26.61
20.37	36.23	3.97	40.85	11.28	26.11
19.78	37.81	3.20	41.98	11.22	27.55
20.28	37.98	3.33	39.71	10.78	28.25
20.13	38.08	2.16	39.69	11.42	28.15
20.52	38.02	4.45	41.33	11.04	26.84
20.69	36.63	3.58	41.19	12.28	....
20.88	37.74	2.03	40.99	10.88	....
20.74	36.28	3.08	40.75	11.26	....
21.43	35.58	2.57	40.67	....	....
20.48	36.41	3.48	....	....	....
20.00	36.95	58.07	....	....	....
19.67	35.09	....	....	....	....
(16.44)	....	....	....	....	....
—2 20.45	+0 37.11	—2 3.49	—1 40.96	+1 11.16	—1 27.55

XIV.	XV.	XVI.	XVII.	XVIII.	XIX.
P. XXII, 222, Groombr. 3914.	1 Cassiopeæ, 60 Pegasi.	79 Pegasi, 7 ρ Cassiop.	84 ψ Pegasi, Bradley 3195.	Bradley 28, 28 Androm.	P. O. 128, 25 ν Cassiop.
′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
−2 52.05	−1 37.19	+0 50.45	+0 7.35	−1 1.05	−0 39.39
51.34	39.84	48.71	(11.83)	0.67	37.81
51.02	38.64	49.25	7.58	0.43	38.31
51.84	37.40	49.64	7.79	1.49	38.35
51.00	38.02	49.27	7.98	0.42	37.89
52.35	34.16	50.42	8.69	0.34	39.75
52.81	37.26	49.47	8.75	1.41	39.63
51.56	37.58	49.00	8.37	1.05	38.70
50.64	37.51	48.78	8.09	1.58	39.75
51.39	37.08	48.58	8.40	0.35	38.50
50.64	36.51	49.27	8.80	....	40.08
52.48	37.17	49.51	8.52	....	....
....	36.96	....	....	....	....
....	36.90	....	....	....	....
−2 51.59	−1 37.30	+0 49.36	+0 8.21	−1 0.88	−0 38.92

The mean error of a determination from a single joint observation of two stars is thus seen to be ± 1″.19; and consequently that of the mean of 17 observations would be ± 0″.29.

The star places have been taken from the best available catalogues, using systematic corrections for referring the declinations to the standard of Argelander's Catalogue for 1830, reduced to Peters's value of the nutation-constant. These declinations, after reference to the mean equinox of 1855.0, were combined by the method of least squares, no arbitrary element entering into the computation, with the exception of the weights assigned to the determinations by different authorities, (which are the same throughout,) and the neglect of proper motion in those instances where its existence seemed very uncertain.

The annexed table shows the discordance of the adopted results from the several catalogue places previous to the application of the systematic corrections:

Bradley 28.		28 Androm.		P. O. 128.		25 ν Cassiop.		P. XVIII, 170.		ν′ Lyræ.		Groomb. 2699.		15 λ Lyræ.		Groomb. 2891.		Groombr. 2925.	
Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.
	″		″		″		″		″		″		″		″		″		″
Bradley	—1.0	Brad	—0.1	Piaz	—0.7	Brad	—1.0	Piaz	—0.1	Brad	—0.3	Groom.	+0.9	Brad	—1.0	Groom.	+1.5	d'Ag	+1.6
Gr. I	+0.1	d'Agel	—2.0	Tayl	+0.3	Piaz	—0.1	Groom	+1.3	d'Ag	(+5.0)	Rob	+0.4	Piaz	—1.7	Rad	—0.1	Groom.	+0.6
Rob	—0.9	Piaz	+0.5	Rob	—0.1	Groom.	+0.9	Tayl	+0.1	Piaz	—0.5	Rad	+0.7	Tayl	+1.1			Rad	0.0
Rad	+0.7	Tayl	—0.6			Tayl	+2.0	Rob	—0.2	Tayl	—0.1	Gr. IV	—0.4	Rob	+1.0				
		Rob	+0.9			Rob	+0.2	Rad	—0.3	Rob	—0.4								
		Gr. II	+0.2			Rad	0.0			Rad	+0.2								
						Gr. IV	—1.0												

Groomb. 2992.		Bradley 2559.		17 Vulpec.		66 Draconis.		42 Cygni.		ω² Cygni.		Groomb. 3248.		α Cygni.		30 Vulpec.		Groombr. 3274.	
Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.
	″		″		″		″		″		″		″		″		″		″
Groom.	+1.8	Brad	—1.5	Brad	—0.4	Brad	—0.5	Brad	—1.3	Brad	—0.5	Groom.	+1.0	Brad	+0.3	Brad	—0.9	Groom.	+1.2
Rad	—0.6	d'Ag	+1.7	d'Agel	—0.4	Piaz	+1.7	d'Ag	+1.8	Piaz	+0.4	Rad	+0.4	Piaz	—1.5	d'Ag	—1.9	Rad	+0.3
		Pond	—0.8	Piaz	—1.8	Groom.	+0.8	Piaz	—2.1	Groom.	+0.9			Groom.	+1.2	Piaz	—1.8		
		Tayl	—0.7	Tay	+1.3	Pond	—0.4	Tayl	+0.3	Tay	—0.4			Bes. '20	+0.5	Tay	—1.0		
		Rob	+0.3	Rob	—0.4	Tayl	+0.9	Rob	—0.1	Rob	+0.8			Str. 24	—0.1	Rob	+1.1		
		Gr. IV	+2.5	Gr. II	+0.6	Gr. I	—0.4			Rad	+0.3			Str. 30	+0.2				
						Rob	—0.7			Gr. IV	+1.0			Argel	—0.3				
						Gr. II	—0.9							Bes 40.	+0.5				
						Rad	+0.6							Bes. 44	—0.1				
						Gr. IV	0.0							Gr. I	—0.2				
														Gr. II	—0.2				
														Gr. III	+0.3				
														Gr. IV	+0.7				
														Wn. '63	—0.5				

Groomb. 3284.		Groomb. 3357.		ξ Cygni.		P. XXI, 86.		Groomb. 3441.		69 Cygni.		73 ρ Cygni.		74 Cygni.		1 (H.) Lacertæ.		2 Lacertæ.	
Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.
	″		″		″		″		″		″		″		″		″		″
Groom.	+1.2	Lal	—2.5	Brad	—0.7	Piaz	—0.7	Groom.	+1.3	Brad	—0.4	Brad	—0.3	Brad	—1.6	d'Ag	+3.3	Brad	+0.2
Rad	+0.2	Groom.	+2.5	Piaz	—1.7	Groom	+1.1	Rad	—0.8	d'Agel	—0.5	d'Ag	—1.8	d'Ag	+3.1	Piaz	—3.9	d'Ag	(+6.7)
		Bes	+1.4	Pond	—1.0	Tay	+1.3	Gr. IV	+1.0	Piaz	—1.4	Piaz	+0.4	Piaz	—3.1	Groom.	+1.9	Piaz	+0.5
		Rad	—3.4	Gr. I	+0.3	Rob	—0.9			Tay	+0.2	Groom.	—0.6	Groom.	+0.4	Pond	—0.8	Groom.	—0.4
				Rad	—0.1	Rad	+0.9			Rob	+0.6	Pond	—0.9	Arg	—0.1	Argel	—0.1	Pond	—0.4
				Gr. II	+0.6							Tayl	+2.5	Tay	+1.4	Tayl	—0.4	Tay	—0.3
				Rob	+1.0							Rob	—1.4	Rob	—0.2	Rob	+0.6	Gr. I	—0.4
				Gr. III	—0.2							Gr. II	+0.3	Rad	—0.1	Rad	+1.2	Rob	—1.1
				Gr. IV	+1.4							Rad	—0.7			Gr. IV	+0.9	Gr. II	—0.2
				Wn. '63	—0.8							Gr. IV	+1.4					Rad	+0.6
																		Gr. III	+0.5
																		Gr. IV	+1.6

P. XXII, 222.		Groomb. 3914.		1 Cassiop.		60 Pegasi.		79 Pegasi.		7 ρ Cassiop.		84 ψ Pegasi.		Bradley 3195.	
Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.	Auth.	C–O.
	″		″		″		″		″		″		″		″
Piaz	—0.3	Groom.	+1.0	Brad	—0.6	Brad	—1.6	Brad	+0.2	Brad	—0.2	Brad	—0.3	Brad	—0.2
Groom	+0.8	Rad	+0.6	Piaz	—0.1	Piaz	—3.2	d'Ag	—0.8	Piaz	—0.7	d'Ag	—0.8	Groom.	+0.4
Taylor	+1.0			Groom.	+1.7	Arg	—0.1	Piaz	+2.4	Groom.	+0.6	Piaz	—2.6	Pond	—0.3
Rob	—0.4			Tay	+0.6	Tay	+1.1	Tay	+1.4	Tayl	+0.9	Tay	—0.3	Tay	0.0
Rad	+0.6			Gr. I	+0.3	Rob	+0.8	Rob	+0.9	Rob	0.0	Rob	+1.2	Rob	—0.4
				Rob	—0.8					Gr. II	+0.5	Gr. 62	+1.5	Gr. II	—0.1
				Gr. II	+0.5					Rad	0.0			Rad	+0.4
				Rad	—0.2									Gr. III	—0.4
														Gr. IV	+1.3

The resultant mean places of the stars are appended, as also the approximate right-ascensions, both referred to the mean equinox of 1855.0.

Pair.	Name.	α.	δ.	μ.	a′.	b′.	c′.	d′.
		h. m. s.	° ′ ″					
I	Piazzi XVIII, 170	18 36 33	52 3 39.30	....	0.50314	9.99445	0.01929	9.09779
	8 ν′ Lyræ	18 44 22	32 38 54.89	....	0.58635	9.99181	9.95356	9.01609
II	Groombr. 2699	18 48 20	54 47 21.22	+0.233	0.62304	9.99027	0.01753	9.22192
	15 λ Lyræ	18 54 32	31 56 42.83	....	0.64767	9.98758	9.94567	9.09598
III	Groombr. 2891	19 31 55	43 23 0.95	....	0.89378	9.96409	9.97668	9.42842
	Groombr. 2925	19 38 55	41 25 38.74	+0.034	0.92373	9.95823	9.96677	9.44212
IV	Groombr. 2992	19 52 21	60 26 23.60	....	0.97507	9.94559	9.99189	9.61227
	Bradley 2559	19 55 36	24 24 4.57	+0.049	0.98645	9.94223	9.88348	9.30029
V	17 Vulpeculæ	20 0 39	23 11 57.29	+0.013	1.00336	9.93681	9.86890	9.29654
	66 Draconis	20 3 14	61 34 31.25	+0.053	1.01165	9.93394	9.98313	9.65362
VI	42 Cygni	20 23 49	35 58 23.86	+0.029	1.07097	9.90821	9.91734	9.53767
	46 ω³ Cygni	20 26 50	48 43 58.02	−0.031	1.07876	9.90400	9.94879	9.65253
VII	Groombr. 3248	20 34 15	40 4 8.19	−0.011	1.09698	9.89317	9.92190	9.60342
	α Cygni	20 36 29	44 45 50.77	−0.003	1.10225	9.88975	9.93167	9.64770
VIII ...	30 Vulpeculæ	20 38 36	24 45 17.66	−0.143	1.10715	9.88739	9.85531	9.42574
	Groombr. 3274	20 39 33	60 4 46.37	−0.083	1.10931	9.88496	9.94521	9.74495
IX	Groombr. 3284	20 42 22	45 2 56.66	+0.006	1.11560	9.88045	9.92633	9.66321
	Groombr. 3357	20 54 22	39 41 8.99	+0.101	1.14078	9.85991	9.90116	9.64374
X	64 ζ Cygni	21 6 46	29 38 3.74	−0.056	1.16418	9.83628	9.85512	9.55607
	Piazzi XXI, 86	21 12 54	55 11 24.66	....	1.17485	9.82360	9.90020	9.78697
XI	Groombr. 3441	21 16 58	48 6 8.80	+0.074	1.18160	9.81483	9.89043	9.75560
	69 Cygni	21 19 52	36 2 34.84	−0.007	1.18627	9.80838	9.86294	9.65370
XII	73 ρ Cygni	21 28 32	44 57 8.87	−0.081	1.19955	9.78683	9.86969	9.74719
	74 Cygni	21 31 8	39 45 51.44	+0.045	1.20336	9.78162	9.85758	9.70704
XIII ...	1 (Hev.) Lacertæ	22 7 40	38 59 49.70	....	1.24783	9.67281	9.80175	9.74442
	2 Lacertæ	22 15 2	45 48 27.65	....	1.25501	9.64554	9.79203	9.80829
XIV	Piazzi XXII, 222	22 40 1	45 27 13.54	−0.013	1.27524	9.53393	9.73885	9.82589
	Groombr. 3914	22 46 34	39 23 53.20	....	1.27955	9.49825	9.72854	9.77988
XV	1 Cassiopeæ	23 0 30	58 38 12.66	....	1.28744	9.40943	9.64831	9.91660
	60 Pegasi	23 4 47	26 3 55.43	−0.098	1.28951	9.37765	9.69429	9.63013
XVI	79 Pegasi	23 42 19	28 2 9.67	+0.048	1.30095	8.88677	9.62245	9.67082
	7 ρ Cassiopeæ	23 47 9	56 41 33.98	....	1.30156	8.74849	9.45503	9.92139
XVII ...	84 ψ Pegasi	23 50 23	24 20 8.93	−0.022	1.30186	8.62291	9.61560	9.61461
	Bradley 3195	23 54 14	60 24 55.50	−0.012	1.30210	8.39957	9.37308	9.93919
XVIII ..	Bradley 28	0 18 44	55 50 16.30	+0.032	1.30079	$_{n}$8.91213	9.24571	9.91629
	28 Andromedæ	0 22 29	28 57 6.22	−0.057	1.30015	$_{n}$8.99090	9.52141	9.68283
XIX	Piazzi, O., 128	0 29 36	34 36 4.78	+0.058	1.29861	$_{n}$9.10996	9.45338	9.75060
	25 ν Cassiopeæ	0 40 38	50 10 34.72	−0.034	1.29537	$_{n}$9.24650	9.15667	9.87849

Calling D the half sum of the mean declinations of a pair, and R the reductions as already determined from the mean of the observations of each pair, we have $\varphi = D + R$, and we may deduce the following places for the latitude of the Cloverden station:

Pair.	D.			R.		φ.			Diff.
	°	′	″	′	″	°	′	″	″
I	42	21	17.10	+1	23.69	42	22	40.79	−0.16
II		22	2.11	+0	38.25			40.36	−0.59
III		24	19.85	−1	38.02			41.83	+0.88
IV		25	14.10	−2	33.04			41.06	+0.11
V		23	14.29	−0	34.43			39.86	−1.09
VI		21	10.94	+1	30.37			41.21	+0.26
VII		24	59.48	−2	18.83			40.65	−0.30
VIII		25	1.93	−2	20.45			41.48	+0.53
IX		22	3.70	+0	37.11			40.81	−0.14
X		24	44.18	−2	3.49			40.69	−0.26
XI		24	21.84	−1	40.96			40.88	−0.07
XII		21	30.14	+1	11.16			41.30	+0.35
XIII		24	8.68	−1	27.55			41.13	+0.18
XIV		25	33.37	−2	51.59			41.78	+0.83
XV		21	4.01	+1	37.30			41.31	+0.36
XVI		21	51.85	+0	49.36			41.21	+0.26
XVII		22	32.20	+0	8.21			40.41	−0.54
XVIII		23	41.25	−1	0.88			40.37	−0.58
XIX	42	23	19.76	−0	38.92			40.84	−0.11
	Mean of all....................					42	22	40.946	....

The mean error of a determination of the latitude by a single pair of stars is thus seen to be $\pm 0''.505$, and that of the final mean $\pm 0''.116$, and we may adopt the value

$42^\circ\ 22'\ 40''.95$, with the probable error $\pm 0''.075$.

By means of observations carefully made by Mr. Boutelle with an 8-inch theodolite, using four points previously determined by the survey, Mr. Schott has deduced at the Washington office the position of Cloverden station as $7''.20$ south and $26''.28$ east of the Cambridge Observatory, whence the latitude of the Observatory would be $42^\circ\ 22'\ 48''.15$.

Prof. Peirce in 1845 found from transit observations in the prime-vertical by Messrs. W. C. Bond, J. D. Graham, and G. P. Bond, the following values for the latitude of the observatory:

	° ′ ″
W. C. Bond, 62 observations..............................	42 22 48.83
J. D. Graham, 41 observations............................	48.29
G. P. Bond, 65 observations..............................	48.86
And the mean of these by weights..........................	42 22 48.60

has been used to the present time. The adoption of later determinations for the declinations of the five stars observed would somewhat diminish the resultant value; but there seems little doubt that this value should be lessened by about half a second, unless strong local disturbances of the plumb-line exist in the vicinity.

Very respectfully, yours,

B. A. GOULD.

Prof. A. D. Bache,

Superintendent United States Coast Survey.

APPENDIX No. 18.

RESULTS OF MAGNETICAL OBSERVATIONS MADE AT EASTPORT, MAINE, BETWEEN 1860 AND 1864, FOR THE UNITED STATES COAST SURVEY.

These observations were made in connection with the general system of magnetical determinations on the coast, and with the special object of ascertaining the law of the secular change in the easternmost coast region of the United States.

At the Eastport station, selected for that purpose, the plan of work required the observation of the magnetic declination, dip, and horizontal intensity during three days near the middle of each month. It is worthy of remark, as a result of these observations, continued for over four years, that the most important magnetic features of a locality may be developed by a system of observations requiring comparatively but a small sacrifice of time, such as it is in the power of many persons to make who are engaged in other pursuits.

The instruments used were a theodolite-magnetometer and a dip-circle, both constructed by Mr. William Wurdemann, according to designs by Mr. J. E. Hilgard.

The principal novelty in the theodolite-magnetometer, besides many details affording greater convenience in making the adjustments than heretofore had, consists in having the collimator magnets so light as to be readily supported by a single silk fibre, the torsion resistance of which is extremely small and susceptible of a stable adjustment. The magnets are $3\frac{1}{2}$ inches long, $\frac{5}{16}$ inch external, and $\frac{4}{16}$-inch internal diameter. By means of verniers the limb can be read to 30″, and may be estimated to 15″. This instrument is represented in Sketch No. 29.

The dip-circle has a diameter of $5\frac{1}{2}$ inches, and reads to 30″ by means of two verniers; the needles are $9\frac{1}{2}$ inches long, and the pointings are made with microscopes attached to the vernier arms on small holes pierced through the needles. Those used during the first half of the series have axles and pivots of the ordinary construction, but from October, 1862, two needles were used, having their axles so fitted in arbors as to admit of being turned about their centres, by which means they may be brought to rest on different parts of the pivots.

The observations were made on each day in three different positions of the pivots, and the errors arising from faults in their figure appear to be very nearly eliminated.

The position of the magnetic observatory is on the parade ground of Fort Sullivan, near Eastport, in latitude 44° 54′.4, longitude 66° 58′.9 west of Greenwich.

The observations were made successively by Messrs. G. B. Vose, S. Walker, R. H. Talcott, E. Goodfellow, A. T. Mosman, and H. W. Richardson, all attached to the Coast Survey.

The discussion herewith presented of the observations has been made by Assistant C. A. Schott. The results are stated under the several heads of declination, dip, and horizontal intensity.

1. Declination. The zero of the collimater magnet, or the position of the magnetic axis on its scale, was determined by inversions each month, and its readings on the circle referred to a distant mark of known azimuth. On four days, about the middle of each month, the declination readings were recorded every half hour between the morning minimum and the afternoon maximum, generally between the hours of 6 a. m. and 2 p. m. Each monthly declination result is therefore the mean from observations made on four days.

To obtain the mean declination of the day, or that value which would result from twenty-four hourly observations, a small correction is applied, derived from the discussion of the Girard College series, which shows that the mean of the least and greatest declination of the day gives the *west* declination too large, as does also the mean of the half hourly readings between those extremes, the amount of excess being the same. We have accordingly the following corrections to our means *expressed in parts of the diurnal range:*

In January	$-\frac{1}{10}$	In May	0	In September	$-\frac{1}{25}$
February	$-\frac{1}{15}$	June	0	October	$-\frac{1}{10}$
March	$-\frac{1}{20}$	July	0	November	$-\frac{1}{10}$
April	$-\frac{1}{20}$	August	0	December	$-\frac{1}{8}$

Diurnal range of the declination.—The difference between the maximum and minimum value of the declination set down in the table for each month is the mean of four days of observations.

	1860.	1861.	1862.	1863.	1864.	Means of 5 years.	Observed annual inequality.	Corrections for 11 years inequality.	Corrected annual inequality.
	′	′	′	′	′	′	′	′	′
January	15.2	8.6	12.1	10.6	11.4	11.6	—2.1	—0.4	—2.5
February	12.6	11.7	11.0	8.0	9.0	10.5	—3.2	—0.3	—3.5
March	16.4	18.1	13.1	11.8	13.0	14.5	+0.8	—0.2	+0.6
April	16.0	13.6	18.4	16.6	11.6	15.2	+1.5	—0.1	+1.4
May	18.7	8.8	14.2	15.6	15.9	14.6	+0.9	0.0	+0.9
June	18.1	12.3	17.7	15.5	13.2	15.4	+1.7	0.0	+1.7
July	13.0	16.3	17.8	14.6	13.6	15.1	+1.4	0.0	+1.4
August	21.5	18.7	19.8	14.5	....	18.3	+4.6	0.0	+4.6
September	19.5	18.8	17.4	15.5	....	17.5	+3.8	+0.1	+3.9
October	18.7	10.4	14.1	14.2	....	14.0	+0.3	+0.2	+0.5
November	13.7	9.2	8.9	8.9	....	9.9	—3.8	+0.3	—3.5
December	7.8	9.0	8.0	6.4	....	7.5	—6.2	+0.4	—5.8
Annual means	15.9	13.0	14.4	12.7	....	13.7	....	....	....

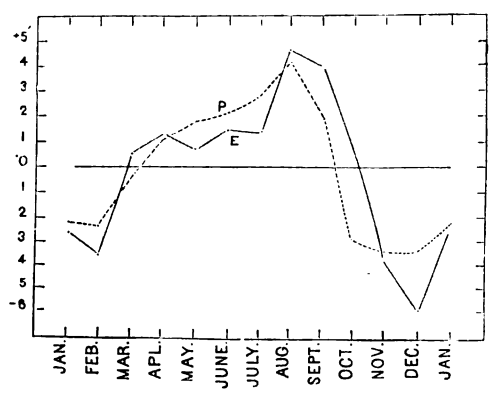
The average difference between the seven values of 1864 and the mean of the four years preceding is —1′.6 Applying this to the four years' means for the remaining five months, the interpolated means for 1864 become, for August, 17′.0; for September, 16′.2; for October, 12′.8; for November, 8′.6; and for December, 6′.2. The column headed "means of five years" is completed with the aid of these values. The interpolated mean for 1864 is 12′.4. The average annual change is — 0′.9.

The eleven-year inequality in the range of the diurnal movement appears quite plainly in the annual means. The year 1860 was one of maximum and 1866 of minimum, according to the observations of the solar spots; in 1865 the average range will therefore be a little above 12′, and in 1866 a little below this value, giving a range of variability due to the eleven years inequality of nearly 4′. The corresponding quantity at Philadelphia is nearly 2′ from observations between 1840 and 1845.

Our series of observations extends over less than one-half of the eleven-year period. A correction has therefore been applied to obtain the annual inequality in the diurnal range free from the eleven-year period, as shown in last column of above table.

The annual inequality of the diurnal range at Eastport and Philadelphia compare as shown by the annexed diagram, the full line being for Eastport, the broken line for Philadelphia. The Toronto curve also agrees well with these curves.

Annual inequality in the diurnal range.



The diurnal range reaches a maximum in August and a minimum in December. There is reason to suppose that the curve is a compound one, consisting of two waves, changing its character according to changes in epochs and amount of these component systems.

Epochs of greatest diurnal deflection.—The average epochs of the morning east elongation and the afternoon west elongation are given in the following table:

	East elongation.	West elongation.		East elongation.	West elongation.
	h. m.	*h. m.*		*h. m.*	*h. m.*
January	8 30	1 20	July	7 20	1 00
February	8 40	1 50	August	7 10	0 20
March	8 20	1 10	September	7 30	0 50
April	7 50	1 10	October	7 50	1 10
May...............	7 10	0 20	November.........	8 00	1 00
June	6 50	0 40	December.........	9 00	1 00

For the summer half year, from April to September included, the morning east elongation occurs at 7*h.* 20*m.*, and for the winter half year from October to March included, the east elongation occurs at 8*h.* 20*m.* At Philadelphia these epochs were 7*h.* 33*m.* and 8*h.* 24*m.*, respectively. For the summer half year the afternoon west elongation occurs at 0*h.* 40*m.*, and for the winter half year at 1*h.* 20*m.* At Philadelphia these epochs were 1*h.* 8*m.* and 1*h.* 25*m.*, respectively. On the average for the year the turning epochs are 7*h.* 50*m.* a. m. and 1*h.* 0*m.* p. m.

Mean monthly values of the declination observed at Eastport between August, 1860, *and July,* 1864.—These values were obtained as follows: Let $D_{\prime}$ = mean of daily minimum and maximum declination, $D_{\prime\prime}$ = mean of all half hourly declinations, between these extremes and including them, then $D = \frac{D_{\prime} + D_{\prime\prime}}{2} + C$ where C = correction to refer the declination to its average value of the day. The minutes given in the table are to be added to 17°.

	1860–'61.	1861–'62.	1862–'63.	1863–'64.	Means.
	′	′	′	′	′
August	58.1	59.5	60.1	64.2	60.5
September	56.9	61.1	61.1	63.6	60.7
October	57.2	60.1	60.8	63.7	60.5
November...........	59.8	61.7	63.5	64.3	62.3
December	58.5	59.2	62.3	62.7	60.6
January	56.5	61.0	62.1	62.8	60.6
February	58.1	60.6	60.5	62.5	60.4
March	58.1	58.4	61.7	63.4	60.4
April	58.7	61.2	62.0	63.0	61.2
May.................	58.0	60.1	61.1	61.6	60.2
June	61.0	59.3	60.7	61.2	60.5
July	58.1	59.2	60.7	62.0	60.0
Means	58.2	60.1	61.4	62.9	60.65

The average value for the period is 18°00′.65.

Annual effect of the secular change.—We deduce the annual effect of the secular change directly from the preceding table.

Annual increase of declination between 1861 and 1862	1′.9
Do............do ....1862 and 1863	1′.3
Do............do ....1863 and 1864	1′.5
Average annual increase of west declination	1′.6

which, considering the locality, appears a remarkably small value. According to our previous information we

might have expected an annual increase of about 4′. Either the above small result indicates a local deviation from the general law, or else at this most *easterly* station we are approaching the period of stationary condition which, from my previous researches, may be expected to take place before the close of the present century.

In July, 1865, the declination was again observed in order to obtain a confirmation of its small annual increase; from four days of observation 18° 04.7′ was found, and since the annual mean is found by adding 1.4′, (vide previous years,) the declination for 1865 becomes 18° 06′.1, and the annual increase apparently equals 2′.4.

The annual mean declination corrected for imperfect number of observations in 1860 and 1864 is as follows:

	° ′
In 1860	17 57.1 W.
In 1861	17 59.2 W.
In 1862	18 00.6 W.
In 1863	18 02.3 W.
In 1864	18 03.7 W.
In 1865	18 06.1 W.

Annual inequality of the declination.—The difficulty of establishing this inequality experimentally is well known, and long-continued and frequent observations have failed to furnish a satisfactory general elucidation of this subject, in reference to which the Coast Survey Report for 1860, p. 311–'12, may be consulted.

The values for Eastport have been derived as follows:

	17°+.	Corrections for secular change.	Corrected declination.	Annual inequality.
	′	′	′	′
August	60.5	+0.7	61.2	+0.55
September	60.7	+0.6	61.3	+0.65
October	60.5	+0.5	61.0	+0.35
November	62.3	+0.3	62.6	+1.95
December	60.6	+0.2	60.8	+0.15
January	60.6	+0.1	60.7	+0.05
February	60.4	—0.1	60.3	—0.35
March	60.4	—0.2	60.2	—0.45
April	61.2	—0.3	60.9	+0.25
May	60.2	—0.5	59.7	—0.95
June	60.5	—0.6	59.9	—0.75
July	60.0	—0.7	59.3	—1.35

The following comparative table contains the annual inequality for Eastport, Philadelphia, and Toronto, the latter for three different epochs, the last two of which are derived from Mr. Kingston's paper on "Monthly Absolute Values of the Magnetic Elements at Toronto, from 1856 to 1864, inclusive."

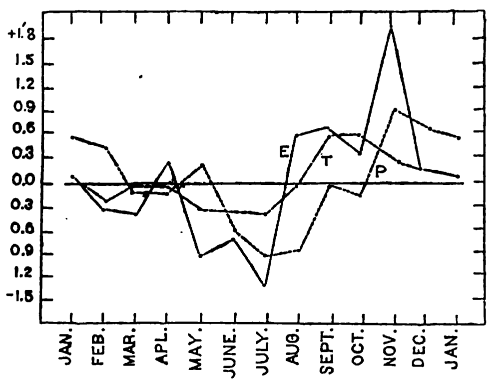
Annual inequality of the magnetic declination.

+ indicates west deflection; — east deflection from normal declination.

	Eastport.	Philadelphia.	Toronto.			
	4 years, 1860–'64.	5 years, 1840–'45.	7 years, 1845–'51.	4 years, 1856–'59.	5 years, 1860–'64.	16 years.
	′	′	′	′	′	′
January	+0.05	+0.5	+0.1	—0.2	+0.10	+0.03
February	—0.35	+0.4	—0.5	+0.2	—0.35	—0.28
March	—0.45	—0.1	—0.2	+0.5	—0.14	0.00
April	+0.25	—0.1	0.0	+0.1	—0.31	—0.07
May	—0.95	+0.2	—0.1	—0.4	—0.67	—0.35
June	—0.75	—0.6	—0.5	—0.7	+0.03	—0.38
July	—1.35	—1.0	—0.8	—0.5	+0.30	—0.38
August	+0.55	—0.9	—0.2	—0.1	+0.19	—0.06
September	+0.65	0.0	+0.7	+0.7	+0.13	+0.52
October	+0.35	—0.2	+1.0	0.0	+0.40	+0.56
November	+1.95	+0.9	+0.3	+0.1	+0.41	+0.29
December	+0.15	+0.7	+0.3	+0.1	—0.07	+0.14

The general agreement of the Eastport, Philadelphia, and the approximate resemblance of the Toronto (16 year) curves, is shown on the annexed diagram.

Annual inequality of the declination



The annual range keeps probably within 2′, and it is not clear whether the annual inequality is subject to a variation of a comparatively short period, a question which remains to be cleared up by future observations. The effect of the annual inequality is to diminish the west declination in July, and to increase it in November, these being the months when it reaches its greatest amount.

2. DIP.—The series of observations and results extends from January, 1860, to July, 1864, during which period the instruments and observers were changed several times. A partial discussion of the observations of 1860–'61–'62, showed an annual *diminution* of the dip of 2′.2 in the first year, and of 3′.0 in the second year. These evidences of a *decreasing* secular change appeared at that time anomalous, but it will be seen that they are borne out by subsequent observations, and likewise in other places. The observations of the dip at Washington in 1860 first *indicated* a change of sign in the secular effect, which fact is now fully established by later observations.

The values given in the following table for each month are the means of observations made on three and sometimes on four days with two needles; the polarity of the needles was reversed during each set:

Monthly means of magnetic dip.

	1860.	1861.	1862.	1863.	1864.
	° ′	° ′	° ′	° ′	° ′
January	75 51.6	75 52.9	75 50.2	75 47.0	75 46.1
February	52.7	53.4	49.5	45.6	46.7
March	54.5	52.7	49.0	47.4	46.7
April	54.4	52.1	49.3	49.0	44.6
May	53.5	49.5	48.1	47.9	46.0
June	51.8	49.8	48.0	48.6	45.6
July	52.9	49.9	48.4	49.1	44.9
August	54.7	50.4	48.2	50.6	....
September	53.5	51.2	48.3	49.8	....
October	53.3	50.9	49.2	49.5	....
November	51.9	49.9	47.4	48.3	....
December	52.3	49.3	46.9	46.8	....
Means	75 53.1	75 51.0	75 48.5	75 48.3	....

In July, 1865, the dip was found, from observations on four days, 75° 44′.7, which, when reduced to the mean of the year, gives 75° 44′.8 for 1865.

	′
1861—1860	—2.1
1862—1861	—2.5
1863—1862	—0.2
1864—1863	—2.0
Mean	—1.7

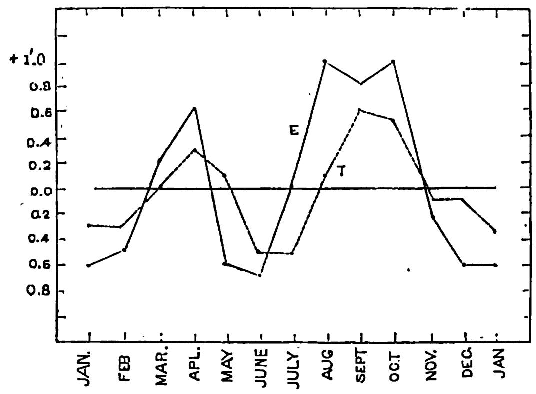
On the average, therefore, the annual diminution is very nearly 1¾.

Annual inequality of the dip.—If we take the monthly means for the four years, 1860–1863, correct them for secular change, the monthly effect of which is —0′.14, and then take the differences of each value from the general mean, we shall have the annual inequality as given in the following table, in which for comparison is likewise given the annual inequality for Toronto, derived by the same treatment from the results given by Mr. Kingston. The annual effect of the secular change for Toronto between 1860 and 1864 is —0′.90, about half that of Eastport: A + sign indicates greater dip, a — sign less dip than the normal value:

	Observed means.	Corrections for secular change.	Corrected dip.	Annual inequality.	
				Eastport.	Toronto.
	° ′	′	° ′	′	′
January	75 50.4	—0.77	75 49.6	—0.6	—0.3
February	50.3	—0.63	49.7	—0.5	—0.3
March	50.9	—0.49	50.4	+0.2	+0.1
April	51.2	—0.35	50.8	+0.6	+0.3
May	49.8	—0.21	49.6	—0.6	+0.1
June	49.6	—0.07	49.5	—0.7	—0.5
July	50.1	+0.07	50.2	0.0	—0.5
August	51.0	+0.21	51.2	+1.0	+0.1
September	50.7	+0.35	51.0	+0.8	+0.6
October	50.7	+0.49	51.2	+1.0	+0.5
November	49.4	+0.63	50.0	—0.2	—0.1
December	48.8	+0.77	49.6	—0.6	—0.1
Mean	75 50.2	....	....	....	....

The law for the two stations is evidently the same, as shown by the annexed diagram. The range of the inequality at Toronto is less than at Eastport, where it hardly reaches $+1'$ and $-1'$. The dip is greater about the equinoxes and less about the solstices, also greatest at the autumnal equinox and least at the winter solstice.

Annual inequality of the dip between 1860 *and* 1864.



3. Horizontal intensity. The observations for horizontal intensity were made by vibrations and deflections with the theodolite-magnetometer on four days near the middle of each month. The moment of inertia and temperature coefficient of the magnet employed were ascertained by numerous experiments. In order to convey an idea of the accuracy of the observations, the values of the magnetic moment of the magnet are subjoined, as resulting from the monthly determinations during the last ten years, when its magnetic condition had become nearly constant:

	1862.	1863.		1863.	1864.
July	0.4017	0.4004	January	0.4007	0.4002
August	.4015	.3999	February	.4006	.4001
September	.4013	.4003	March	.4007	.4003
October	.4016	.4003	April	.4008	.4003
November	.4012	.4003	May	.4008	.4007
December	.4009	.4000	June	.4006	.4001

Table of observed values of the horizontal force.

	1860.	1861.	1862.	1863.	1864.	Mean 1860–'64, 5 years.
January	3.298	3.306	3.297	3.304	3.308	3.303
February	3.299	3.311	3.300	3.304	3.308	3.304
March	3.300	3.308	3.302	3.307	3.311	3.306
April	3.311	3.307	3.302	3.314	3.313	3.309
May	3.309	3.315	3.307	3.318	3.315	3.313
June	3.313	3.316	3.309	3.314	3.320	3.314
July	3.315	3.316	3.305	3.313	3.320	3.314
August	3.306	3.305	3.306	3.311	....	3.308
September	3.307	3.308	3.304	3.308	....	3.308
October	3.307	3.297	3.303	3.306	....	3.304
November	3.308	3.297	3.304	3.308	....	3.305
December	3.309	3.297	3.302	3.308	....	3.305
Mean	3.307	3.307	3.303	3.310	....	3.308

In computing the last column, the wanting values for 1864 have been supplied by interpolation. In July, 1865, from observations on four days, the horizontal force was found 3.319; referring this to the annual mean, we subtract 0.006, and obtain for 1865 the value 3.313.

Secular change of the horizontal force.—Examining the annual means we notice at first a diminution of the force till the beginning of the year 1862, the force after this date shows an annual increase of 0.0012 parts of the force. In a previous discussion (Coast Survey Report, 1861, Appendix No. 22) the horizontal force along the Atlantic coast was found to diminish annually 0.0011 parts of the force. This diminution, according to the Eastport observations, has now ceased and changed to an increase. This reversal of the change corresponds to the observed diminutions of the dip, and is supported by the Toronto observations where it took place, according to G. T. Kingston, director of the observatory in 1860, which is the year of minimum force. At Toronto the present annual increase amounts to 0.0010 parts of the force.

We have further the following table of the total force F=H sec. I from the Eastport observations:

	I.	H.	F.
	° ′		
1860	75 53.1	3.307	13.56
1861	75 51.0	3.307	13.53
1862	75 48.5	3.303	13.47
1863	75 48.3	3.310	13.50
1864	75 46.3	3.313	13.48

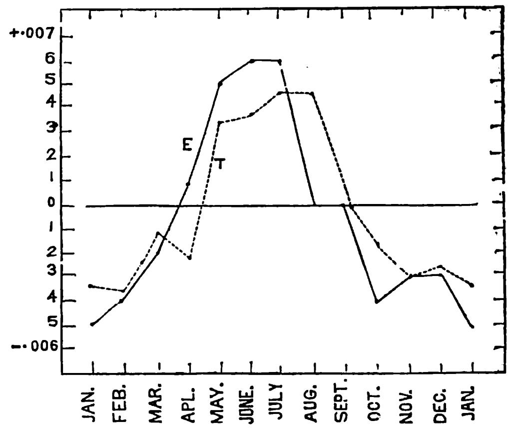
The total force appears to be decreasing in conformity with the diminution of the dip; at Toronto it has likewise decreased between 1845 and 1864. From observations at Key West, Florida, it appears that both the horizontal and total forces were diminishing between 1860–1864.

Annual inequality of the horizontal force. The annual variation can be found directly by subtracting the annual mean from each monthly result, since the minimum year is nearly midway between the extreme epochs. At Toronto, likewise, the minimum year is midway between the extreme years; the series there extends over nine years, between 1856 and 1864.

Annual inequality of the horizontal force at Eastport, 1860–1864, ($4\frac{1}{2}$ *years*;) *at Toronto*, 1856–1864, 9 *years*.

	H. at Eastport.	Annual inequality, Eastport.	H. at Toronto.	Annual inequality, Toronto.
January	3.303	—.005	3.4850	—.0034
February	.304	—.004	.4847	—.0037
March	.306	—.002	.4873	—.0011
April	.309	+.001	.4863	—.0021
May	.313	+.005	.4918	+.0034
June	.314	+.006	.4921	+.0037
July	.314	+.006	.4931	+.0047
August	.308	.000	.4930	+.0046
September	.308	.000	.4889	+.0005
October	.304	—.004	.4868	—.0016
November	.305	—.003	.4855	—.0029
December	.305	—.003	.4858	—.0026
Means	3.308	....	3.4884	....

Annual inequality of horizontal force.



The agreement in the annual inequality at the two places is as close as can possibly be expected. For stricter comparison it would be necessary to convert the tabular numbers of the inequality into parts of the respective forces.

APPENDIX No. 19.

DISTRIBUTION OF THE MAGNETIC DECLINATION ON THE COAST AND PARTS OF THE INTERIOR OF THE UNITED STATES, ACCOMPANIED BY A CHART OF THE ISOGONIC LINES FOR THE EPOCH 1870, AND A SMALL CHART OF ISOMAGNETIC LINES OF EQUAL ANNUAL CHANGE, BY CHARLES A. SCHOTT, ASSISTANT UNITED STATES COAST SURVEY.

DECEMBER, 1865.

The unceasing changes to which the magnetic declination (variation of the compass needle) is subject, render necessary a frequent reconstruction of our magnetic charts, which exhibit the distribution of this component of the terrestrial magnetism for stated epochs. The first chart issued by this office referred to the year 1850, for which see Coast Survey Report of 1856, Appendix No. 28, "On the general distribution of terrestrial magnetism in the United States, from observations made in the United States Coast Survey and others, by A. D. Bache, Superintendent, and J. E. Hilgard, Assistant, United States Coast Survey." The secular change of the declination was then so imperfectly known that the mean of the times of observation had to be taken for the epoch of the representation. Continued observation of this most important change has enabled us now to produce a chart even a few years in advance of date, and to the accuracy of which the accumulated results of the Coast Survey, as well as of other government surveys, have been made to contribute. A comparison of the two charts exhibits the effect of the action of the secular change during twenty years, which consists principally in a southerly movement of the curves along the Atlantic and Pacific seaboards crowding in upon those of the Gulf of Mexico. Partial charts for the intermediate decade (1860) have been constructed, for which see Coast Survey Report of 1861, Appendices Nos. 23 and 24.

The annual effect of the secular change requires our special attention. In the present communication the additional material will be offered which has been collected since the publication of my paper in the Coast Survey Report of 1859, Appendix No. 24.

As a first attempt, the chart of lines of equal annual change (Sketch No. 28) can claim but very moderate accuracy; it has been supposed, however, that enough information had accumulated to attempt its construction. The curves unite places of equal annual change, and by their distribution furnish us with ready means to refer any observed magnetic declination (within their limits) taken within the past decade to the present value, or to an epoch a few years in advance. These lines themselves change in the course of time, as is sufficiently plain from the discussion referred to above, but they may be taken to answer for about a decade either way from date without passing beyond the limit of uncertainty to which the observations themselves

are subject. The year 1860 may be taken for their average epoch. The curves marked thus: II, III, IV, V, indicate the localities where the *annual* increase of west declination amounted, on the average, to as many minutes between the years 1850 and 1860.

The change at Eastport, Maine, $+1'.6$, appears singularly small; but monthly observations continued between 1860 and 1864, and a verification of last summer will not admit of any other value. For the greater part of our Atlantic coast the annual change is confined between $+2'$ and $+3'$ less on the southern coast, though careful observations at Key West between 1860 and 1865 give the comparatively large value $+2'.9$. Proceeding westward on the Gulf coast the annual change becomes less, and at the Mississippi delta it is but a fraction of a minute. The Coast Survey Report of 1861, pp. 252 and 256, contains the numerical quantities for our southern coast. If we start from the extreme northeast in a southwesterly direction, we shall find the annual change as follows: along the St. Lawrence river, between the Saguenay river and Quebec, $+6'$; between Quebec and Montreal, about $+5'$; between Montreal and Kingston, about $+4'$; at Portland, Maine, $+3'.2$, (from the most recent observations;) along Lake Ontario, $+4'$; at Toronto, $+3'.1$, (from a table of absolute values published by G. T. Kingston, director of the observatory;) at Buffalo, $+3'.6$; at Dunkirk, $+4'.3$; at Lake St. Clair, $+2'.9$. The average value for Pennsylvania is about $+2'.7$, (see record and results of a magnetic survey of Pennsylvania, &c, &c., by A. D. Bache, LL.D.; Smithsonian contributions to knowledge, October, 1863;) at Parkersburg, West Virginia, $+3'.2$; at Cairo, Illinois, $+2'.0$, apparently a reliable value; at Florence, Alabama, $+2'.3$, a very reliable value. The value of $+0'.8$ for Chicago, Illinois, seems too small, though it is certain that the secular change must pass through zero and increase the eastern declinations along our Pacific coast. Taking a glance at the West Indies and Central American regions, we find at Havana, Cuba, and in Jamaica, the easterly declination still on the *decrease*, and the dividing region between stations of decreasing and increasing easterly declination appears to lie somewhere between Panama and Vera Cruz. At the city of Mexico the east declination *increases* about $1'$ a year, and at San Blas, Mexico, about $3'$. For California, Oregon, and Washington, the value formerly assumed by me (in 1856 and 1859, Coast Survey Reports) appears now too small, though we possess as yet no precise information. According to Colonel Ransom's paper, (vol. II of the Proceedings of the California Academy of Natural Sciences, 1858–'62, San Francisco, 1863,) the annual increase of easterly declination for the epoch 1855 is between $2\frac{1}{2}$ and $4'$, though $7'$ is said to have been observed in Almeda county. I feel inclined to assume now an annual increase of $2\frac{3}{4}'$ along our western coast; $3'$ may be taken under the 49th parallel and west of the Rocky mountains. Higher north, at Sitka, Russian America, the east declination increases about $4'.7$ per annum. It is in contemplation to have special observations made on the Texan and western coast, for the purpose of a precise determination of the annual change in these localities.

The analytical formula of interpolation is the same as that hitherto employed, but the method of discussion is improved by making use of the former isogonic lines for the purpose of applying Peirce's criterion for the rejection of doubtful observations, which gives the advantage of excluding beforehand all such results, without the necessity of reconstructing the general formulæ. The chart depends upon the observations made by the United States Coast Survey, the United States lake survey, (received through the kindness of Colonel W. F. Raynolds, superintendent,) the United States northwest boundary survey, (received through the kindness of Hon. Archibald Campbell, commissioner,) and upon other sources, viz: the magnetic survey of Pennsylvania, by A. D. Bache; of the Yellowstone and Upper Missouri rivers, by Colonel W. F. Raynolds, United States engineers; of observations taken by a Coast Survey party in Tennessee, Alabama, Missouri, and Illinois, near the close of the war. Some results were taken from British admiralty charts and from miscellaneous sources, comprising in all 435 individual determinations, 27 of which were rejected by the use of the criterion. These observations were divided into twenty-six groups, for the convenience of numerical treatment; in each group the declinations were arranged in their geographical order, the observations having previously been referred to the common epoch 1870. The mean latitude, (φ_0,) the mean longitude, (λ_0,) and the mean declination (D_0) were made out; each observation was next referred differentially, by a graphical measure from the former isogonic curves, to the mean of the group, and to these last values the criterion was applied. These results by groups were then arranged in three great divisions, the eastern, middle, and western divisions, each group furnishing a conditional equation of the form:

$O = D_0 - D + d + X\Delta\varphi + y\Delta\lambda \cos.\varphi + z\Delta\varphi\Delta\lambda \cos.\varphi + p\Delta\varphi^2 + q\Delta\lambda^2 \cos.^2\varphi$ where $\Delta\varphi = \varphi - \varphi_0$ and $\Delta\lambda = \lambda - \lambda_0$. From these six normal equations were formed and solved. The isogonic curves on the chart were laid down from the analytical expressions thus obtained.

For the use of the navigator the "variation" can be taken at once from the chart by inspection. For the surveyor, however, who desires greater accuracy, a simple graphical interpolation is required, which will give the declination within a few minutes. An allowance is to be made for secular change, also for diurnal variation, which latter quantity is itself variable within each month of the year and within a cycle of about eleven years. The annual variation may be neglected. Times of magnetic disturbance are of course to be avoided in observing, as well as places affected by local attraction. It is intended to give in a future paper the laws of the diurnal variation of the declination in its annual and decennial fluctuations and its dependence upon the magnetic latitude. The reader may consult here Coast Survey Report 1859, Appendix No. 22, and Coast Survey Report 1860, Appendix No. 23.

APPENDIX No. 20.

PROJECTION TABLE FOR A MAP OF NORTH AMERICA.

The extended projection tables given in the Coast Survey Reports for 1856 and 1859 suffice fully for any map of the United States. In order to supply the want of similar data for the whole of North America, the subjoined table has been computed upon the same system of representation, the polyconic development of the surface. Each parallel is developed on a tangent cone unrolled upon the plane of the map; each is therefore an arc of a circle, on which the degrees of longitude have their true length.

The co-ordinates x and y give the points of intersection of the meridians and parallels, x being measured to the east or west of the middle meridian on a line at right angles to it and tangent to the parallel of latitude, and y being measured at right angles to x from its extremity northwardly. The annexed diagram shows the arrangement of the map and the limits for which the projections are given. The table gives the co-ordinates for every 5° of latitude and longitude. The numbers are metres, and correspond to the actual magnitude of the earth. They need only be divided by the ratio of the scale used to the natural size; or a scale may be drawn such that the figures in the table can at once be used.

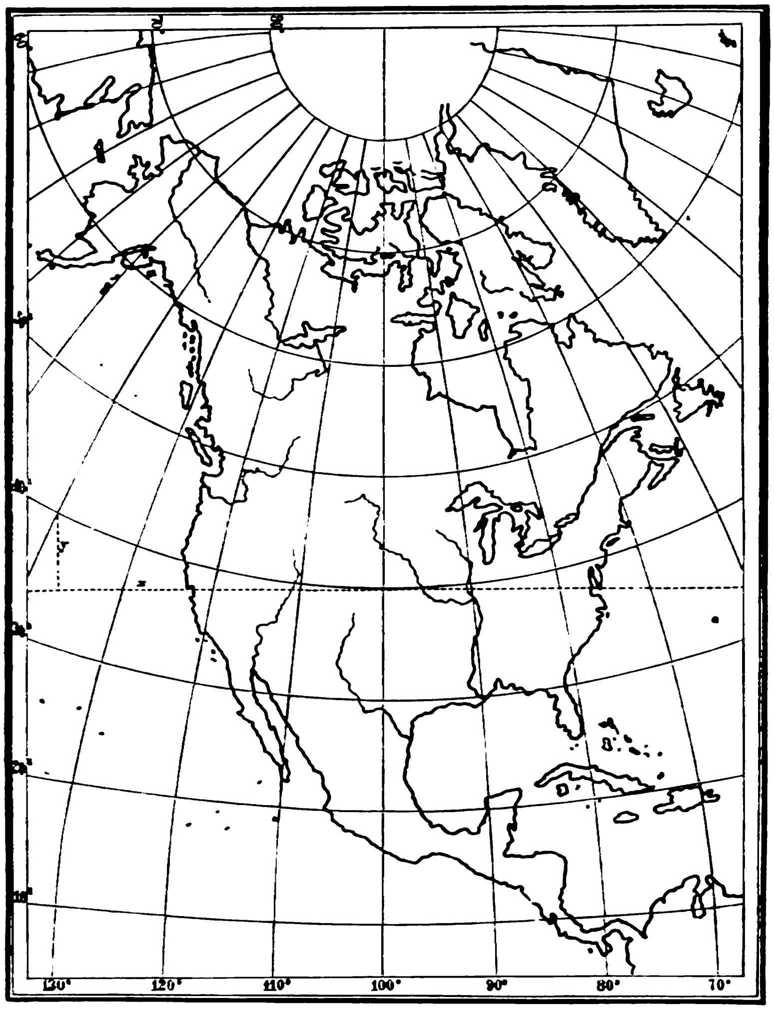


Table of lengths (in metres) of five degrees of latitude on the straight meridian.		*Table of lengths (in metres) of the radii of the parallels, and of five degrees of longitude on each parallel.*		
Latitude.	5° of latitude.	Latitude.	Radius of parallel.	5° of longitude.
° °	*Metres.*	°	*Metres.*	*Metres.*
0 to 5	552,832	0	Infinite	556,533
5 to 10	552,916	5	72,895,830	554,429
10 to 15	553,081	10	36,171,660	548,133
15 to 20	553,322	15	23,806,090	537,690
20 to 25	553,633	20	17,528,600	523,174
25 to 30	554,003	25	13,684,530	504,691
30 to 35	554,422	30	11,055,200	482,374
35 to 40	554,877	35	9,117,582	456,387
40 to 45	555,354	40	7,610,787	426,918
45 to 50	555,840	45	6,388,064	394,187
50 to 55	556,319	50	5,361,783	358,435
55 to 60	556,777	55	4,475,535	319,932
60 to 65	557,200	60	3,691,243	278,966
65 to 70	557,574	65	2,982,014	235,849
70 to 75	557,888	70	2,328,053	190,909
75 to 80	558,132	75	1,714,164	144,492
80 to 85	558,300	80	1,128,165	96.955
85 to 90	558,385	85	559,807	48,667

I.—*Table of co-ordinates.*

Longitude.	Latitude 5°.		Latitude 10°.		Longitude.	Latitude 15°.		Latitude 20°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
5	554,424	2,108	548,112	4,153	5	537,644	6,072	523,096	7,807
10	1,108,815	8,433	1,096,098	16,612	10	1,075,013	24,285	1,045,727	31,221
15	1,663,144	18,975	1,643,833	37,372	15	1,611,835	54,629	1,567,426	70,221
20	2,217,375	33,732	2,191,188	66,429	20	2,147,834	97,089	2,087,728	124,772
25	2,771,479	52,704	2,738,043	103,778	25	2,682,738	151,643	2,606,172	194,827
30	3,325,421	75,891	3,284,269	149,409	30	3,216,273	218,265	3,122,293	280,322
35	3,879,163	103,288	3,829,745	203,314	35	3,748,166	296,918	3,635,631	381,182
40	4,432,688	134,897	4,374,342	265,475	40	4,278,144	387,565	4,145,736	497,316
45	4,985,955	170,716	4,917,917	335,881	45	4,805,951	490,159	4,652,138	628,617

Longitude.	Latitude 25°.		Latitude 30°.		Longitude.	Latitude 35°.		Latitude 40°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
5	504,577	9,305	482,221	10,522	5	456,196	11,419	426,695	11,971
10	1,008,467	37,209	963,524	42,068	10	911,249	45,650	852,045	47,845
15	1,510,986	83,673	1,442,994	94,579	15	1,364,019	102,605	1,274,717	107,509
20	2,011,450	148,636	1,919,715	167,953	20	1,813,373	182,142	1,693,379	190,777
25	2,509,178	232,007	2,392,784	262,052	25	2,258,185	284,062	2,106,714	297,386
30	3,003,493	333,672	2,861,297	376,697	30	2,697,341	408,110	2,513,422	427,000
35	3,493,726	453,498	3,324,363	511,668	35	3,129,738	553,974	2,912,222	579,212
40	3,979,203	591,314	3,781,102	666,710	40	3,554,298	721,291	3,301,863	753,545
45	4,459,275	746,940	4,230,643	841,527	45	3,969,954	909,640	3,681,119	949,447
50	....	....	4,672,231	1,035,787	50	4,375,667	1,118,550	4,048,793	1,166,305
					55	4,770,419	1,347,497	4,403,731	1,403,435

Longitude.	Latitude 45°.		Latitude 50°.	
	x.	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
5	393,936	12,158	358,168	11,976
10	786,373	48,586	714,736	47,851
15	1,175,817	109,145	1,068,111	107,465
20	1,560,784	193,605	1,416,715	190,552
25	1,939,811	301,645	1,758,990	296,739
30	2,311,449	432,852	2,093,407	425,553
35	2,674,299	586,730	2,418,473	576,419
40	3,026,963	762,688	2,732,734	748,662
45	3,368,104	960,061	3,034,787	941,514
50	3,696,425	1,178,093	3,323,284	1,154,111
55	4,010,675	1,415,960	3,596,933	1,385,505
60	4,309,660	1,672,749	3,854,515	1,634,663
65	....	....	4,094,878	1,900,471

I.—*Table of co-ordinates*—Continued.

Longitude.	Latitude 55°.		Latitude 60°.		Longitude.	Latitude 65°.		Latitude 70°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
5	319,658	11,430	278,701	10,536	5	235,602	9,322	190,695	7,823
10	637,686	45,662	555,809	42,086	10	469,732	37,229	380,108	31,240
15	952,454	102,522	829,745	94,467	15	700,924	83,547	566,967	70,094
20	1,262,357	181,718	1,098,944	167,382	20	927,736	147,986	750,016	124,123
25	1,565,815	282,846	1,361,870	260,414	25	1,148,746	230,144	928,022	192,964
30	1,861,272	405,390	1,617,019	373,033	30	1,362,573	329,506	1,099,793	276,155
35	2,147,222	548,724	1,862,939	504,594	35	1,567,884	445,452	1,264,172	373,136
40	2,422,207	712,114	2,098,223	654,347	40	1,763,391	577,257	1,420,054	483,257
45	2,684,817	894,729	2,321,529	821,440	45	1,947,873	724,095	1,566,393	605,774
50	2,933,716	1,095,635	2,531,582	1,004,913	50	2,120,178	885,051	1,702,205	739,867
55	3,167,628	1,313,801	2,727,181	1,203,723	55	2,279,226	1,059,117	1,826,575	884,636
60	3,385,359	1,548,120	2,907,213	1,416,732	60	2,424,026	1,245,203	1,938,670	1,039,104
65	3,585,801	1,797,393	3,070,646	1,642,731	65	2,553,669	1,442,150	2,037,736	1,202,235
70	3,767,925	2,060,340	3,216,550	1,880,420	70	2,667,348	1,648,725	2,123,105	1,372,934
75	3,930,805	2,335,630	3,344,091	2,128,448	75	2,764,350	1,863,634	2,194,207	1,550,050
80	4,073,606	2,621,847	3,452,541	2,385,397	80	2,844,069	2,085,534	2,250,561	1,732,395
85	4,195,598	2,917,530	3,541,281	2,649,804	85	2,906,008	2,313,041	2,291,789	1,918,746
90	4,296,161	3,221,176	3,609,806	2,920,153	90	2,949,778	2,544,730	2,317,615	2,107,845
95	4,374,780	3,531,230	3,657,721	3,194,904	95	2,975,105	2,779,152	2,327,865	2,298,425
100	4,431,052	3,846,104	3,684,755	3,472,493	100	2,981,834	3,014,843	2,322,468	2,489,205
105	....	....	3,690,754	3,751,326	105	2,969,919	3,250,329	2,301,465	2,678,900

Longitude.	Latitude 75°.		Latitude 80°.		Latitude 85°.	
	x.	*y.*	*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	*Metres.*	*Metres.*
5	144,321	6,086	96,836	4,164	48,605	2,114
10	287,617	24,302	192,957	16,624	96,843	8,440
15	428,871	54,517	287,654	37,289	144,350	18,931
20	567,079	96,517	380,228	66,005	190,766	33,507
25	701,260	150,006	469,995	102,562	235,742	52,058
30	830,462	214,600	556,292	146,689	278,937	74,443
35	953,766	289,843	638,485	198,061	320,025	100,495
40	1,070,298	375,202	715,964	256,298	358,697	130,016
45	1,179,229	470,067	788,158	320,970	394,659	162,783
50	1,279,787	573,767	854,535	391,601	427,640	198,548
55	1,371,256	685,566	914,604	467,668	457,391	237,042
60	1,452,989	804,668	967,922	548,610	483,688	277,974
65	1,524,403	930,229	1,014,096	633,831	506,332	321,034
70	1,584,992	1,061,357	1,052,784	722,700	525,151	365,898
75	1,634,327	1,197,120	1,083,702	814,563	540,004	412,227
80	1,672,056	1,336,554	1,106,620	908,739	550,778	459,670
85	1,697,911	1,478,672	1,121,370	1,004,536	557,393	507,869
90	1,711,709	1,622,460	1,127,843	1,101,245	559,797	556,461
95	1,713,353	1,766,899	1,125,991	1,198,152	557,974	605,078
100	1,702,830	1,910,965	1,115,829	1,294,544	551,936	653,353
105	1,680,214	2,053,633	1,097,429	1,389,706	541,729	700,923
110	1,645,667	2,193,890	1,070,930	1,482,939	527,431	747,425

TABLE II.—*Co-ordinate of curvature.*

Longitude.	Latitude 55°.		Latitude 56°.		Longitude.	Latitude 57°.		Latitude 58°.	
	x.	*y.*	*x.*	*y.*		*x*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	63,984	457	62,382	451	1	60,762	445	59,123	438
2	127,956	1,829	124,753	1,805	2	121,512	1,779	118,234	1,750
3	191,899	4,116	187,096	4,061	3	182,235	4,002	177,318	3,938
4	255,804	7,316	249,402	7,219	4	242,920	7,114	236,364	6,999
5	319,657	11,430	311,654	11,278	5	303,552	11,113	295,358	10,934
6	383,447	16,456	373,840	16,238	6	364,120	16,000	354,287	15,742
7	447,156	22,394	435,951	22,097	7	424,609	21,772	413,139	21,422
8	510,775	29,242	497,967	28,854	8	485,007	28,430	471,900	27,972
9	574,288	36,999	559,880	36,507	9	545,302	35,971	530,559	35,391
10	637,686	45,662	621,677	45,055	10	605,479	44,393	589,099	43,677
11	700,951	55,232	683,343	54,496	11	665,528	53,696	647,511	52,829
12	764,075	65,705	744,865	64,830	12	725,433	63,876	705,783	62,844
13	827,041	77,079	806,233	76,052	13	785,183	74,932	763,897	73,721
14	889,839	89,352	867,431	88,161	14	844,764	86,861	821,846	85,456
15	952,454	102,522	928,446	101,153	15	904,165	99,661	879,616	98,049
16	1,014,876	116,586	989,270	115,028	16	963,372	113,330	937,192	111,494
17	1,077,089	131,540	1,049,884	129,781	17	1,022,372	127,863	994,561	125,791
18	1,139,083	147,382	1,110,281	145,409	18	1,081,153	143,259	1,051,714	140,935
19	1,200,843	164,110	1,170,443	161,910	19	1,139,704	159,513	1,108,637	156,922
20	1,262,357	181,718	1,230,360	179,280	20	1,198,010	176,622	1,165,317	173,752
21	1,323,616	200,203	1,290,019	197,513	21	1,256,059	194,583	1,221,740	191,418
22	1,384,601	219,564	1,349,411	216,610	22	1,313,838	213,393	1,277,897	209,917
23	1,445,306	239,794	1,408,517	236,563	23	1,371,336	233,046	1,333,774	229,245
24	1,505,713	260,890	1,467,331	257,369	24	1,428,540	253,538	1,389,357	249,399
25	1,565,815	282,845	1,325,836	279,024	25	1,485,441	274,865	1,444,637	270,373
26	1,625,594	305,660	1,584,021	301,524	26	1,542,021	297,022	1,499,601	292,161
27	1,685,043	329,327	1,641,877	324,862	27	1,598,270	320,006	1,554,237	314,762
28	1,744,146	353,841	1,699,387	349,036	28	1,654,177	343,810	1,608,530	338,169
29	1,802,895	379,196	1,756,541	374,040	29	1,709,730	368,430	1,662,472	362,377
30	1,861,272	405,390	1,813,330	399,866	30	1,764,916	393,861	1,716,051	387,381

Longitude.	Latitude 59°.		Latitude 60°.		Longitude.	Latitude 59°.		Latitude 60°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	57,466	480	55,799	422	16	910,735	109,523	884,014	107,419
2	114,919	1,719	111,569	1,687	17	966,461	123,565	938,081	121,190
3	172,347	3,868	167,322	3,794	18	1,021,974	138,439	991,931	135,776
4	229,736	6,876	223,036	6,744	19	1,077,251	154,142	1,045,557	151,175
5	287,073	10,742	278,699	10,536	20	1,132,290	170,670	1,098,944	167,382
6	344,346	15,465	334,301	15,169	21	1,187,077	188,020	1,152,079	184,395
7	401,542	21,055	389,823	20,642	22	1,241,597	206,187	1,204,952	202,208
8	458,649	27,479	445,257	26,953	23	1,295,840	228,168	1,257,549	220,818
9	515,652	34,767	500,590	34,101	24	1,349,792	244,958	1,309,859	240,222
10	572,541	42,907	555,809	42,086	25	1,403,444	265,553	1,361,870	260,414
11	629,301	51,897	610,900	50,903	26	1,456,781	286,949	1,413,569	281,390
12	685,920	61,736	665,852	60,553	27	1,509,791	309,139	1,464,946	303,144
13	742,385	72,420	720,652	71,031	28	1,562,463	332,121	1,515,988	325,674
14	798,685	83,948	775,288	82,336	29	1,614,786	355,888	1,566,682	348,971
15	854,806	96,316	829,745	94,467	30	1,666,747	380,435	1,617,019	373,033

TABLE II.—*Co-ordinates of curvature*—Continued.

Longitude.	Latitude 61°.		Latitude 62°.		Longitude.	Latitude 63°.		Latitude 64°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	54,099	413	52,390	404	1	50,664	394	48,924	384
2	108,185	1,652	104,767	1,615	2	101,316	1,576	97,835	1,535
3	162,246	3,716	157,119	3,633	3	151,945	3,545	146,723	3,453
4	216,268	6,605	209,434	6,457	4	202,536	6,301	195,574	6,138
5	270,241	10,318	261,700	10,087	5	253,077	9,844	244,377	9,589
6	324,151	14,855	313,903	14,522	6	303,558	14,172	293,121	13,805
7	377,985	20,214	366,032	19,761	7	353,966	19,285	341,792	18,785
8	431,732	26,394	418,073	25,803	8	404,288	25,181	390,379	24,527
9	485,377	33,394	470,016	32,647	9	454,512	31,858	438,869	31,032
10	538,909	41,213	521,846	40,289	10	504,625	39,316	487,253	38,296
11	592,315	49,847	573,553	48,730	11	554,619	47,553	535,515	46,318
12	645,585	59,295	625,123	57,966	12	604,476	56,565	583,647	55,097
13	698,703	69,555	676,545	67,995	13	654,188	66,352	631,635	64,629
14	751,658	80,625	727,808	78,816	14	703,741	76,911	679,466	74,912
15	804,440	92,502	778,897	90,426	15	753,126	88,239	727,132	85,945
16	857,032	105,185	829,801	102,822	16	802,326	100,334	774,617	97,725
17	909,425	118,667	880,507	116,000	17	851,334	113,192	821,913	110,247
18	961,607	132,948	931,005	129,958	18	900,134	126,811	869,007	123,510
19	1,013,564	148,024	981,281	144,693	19	948,718	141,187	915,885	137,510
20	1,065,285	163,891	1,031,324	160,201	20	997,073	156,316	962,540	152,244
21	1,116,759	180,545	1,081,122	176,478	21	1,045,186	172,196	1,008,956	167,707
22	1,167,971	197,984	1,130,664	193,520	22	1,093,046	188,823	1,055,126	183,897
23	1,218,911	216,203	1,179,939	211,324	23	1,140,642	206,192	1,101,034	200,810
24	1,269,567	235,196	1,228,932	229,885	24	1,187,961	224,298	1,146,673	218,439
25	1,319,929	254,961	1,277,633	249,199	25	1,234,996	243,138	1,192,029	236,783
26	1,369,981	275,492	1,326,031	269,261	26	1,281,729	262,707	1,237,091	255,837
27	1,419,715	296,784	1,374,114	290,068	27	1,328,154	283,000	1,281,851	275,594
28	1,469,119	318,834	1,421,870	311,612	28	1,374,257	304,013	1,326,292	296,051
29	1,518,179	341,636	1,469,289	333,889	29	1,420,028	325,740	1,370,410	317,203
30	1,566,885	365,183	1,516,359	356,894	30	1,465,456	348,178	1,414,188	339,045

Longitude.	Latitude 65°.		Latitude 66°.		Longitude.	Latitude 65°.		Latitude 66°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	47,168	373	45,397	362	16	746,683	94,996	718,532	92,153
2	94,324	1,492	90,783	1,448	17	792,255	107,168	762,369	103,959
3	141,456	3,357	136,145	3,257	18	837,629	120,059	806,011	116,463
4	188,553	5,967	181,473	5,789	19	882,793	133,666	849,449	129,661
5	235,602	9,322	226,755	9,043	20	927,736	147,986	892,671	143,549
6	282,588	13,420	271,979	13,020	21	972,447	163,015	935,665	158,125
7	329,514	18,262	317,134	17,716	22	1,016,914	178,749	978,423	173,385
8	376,351	23,844	362,208	23,132	23	1,061,127	195,184	1,020,932	189,325
9	423,095	30,167	407,191	29,266	24	1,105,075	212,318	1,063,180	205,940
10	469,732	37,229	452,069	36,116	25	1,148,746	230,144	1,105,159	223,227
11	516,252	45,027	496,833	43,681	26	1,192,129	248,658	1,146,857	241,180
12	562,643	53,558	541,472	51,959	27	1,235,214	267,857	1,188,262	259,797
13	608,893	62,826	585,971	60,948	28	1,277,991	287,734	1,229,367	279,071
14	654,991	72,823	630,322	70,644	29	1,320,447	308,286	1,270,157	298,991
15	700,924	83,547	674,513	81,047	30	1,362,573	329,506	1,310,626	319,574

II.—*Table of co-ordinates*—Continued.

Longitude.	Latitude 67°.		Latitude 68°.		Longitude.	Latitude 69°.		Latitude 70°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	43,612	350	41,815	338	1	40,004	326	38,180	313
2	87,214	1,401	83,618	1,353	2	79,996	1,304	76,350	1,252
3	130,793	3,153	125,400	3,045	3	119,968	2,933	114,449	2,817
4	174,338	5,604	167,148	5,412	4	159,908	5,213	152,618	5,007
5	217,838	8,754	208,853	8,454	5	199,805	8,144	190,695	7,823
6	261,282	12,603	250,504	12,171	6	239,649	11,724	228,722	11,263
7	304,658	17,149	292,088	16,561	7	279,430	15,953	266,686	15,325
8	347,957	22,392	333,597	21,624	8	319,136	20,830	304,578	20,010
9	391,164	28,329	375,018	27,358	9	358,758	26,353	342,389	25,315
10	434,271	34,960	416,340	33,761	10	398,285	32,520	380,108	31,240
11	477,266	42,282	457,554	40,832	11	437,705	39,331	417,725	37,783
12	520,137	50,295	498,648	48,569	12	477,010	46,784	455,229	44,942
13	562,874	58,994	539,611	56,970	13	516,188	54,876	492,611	52,714
14	605,468	68,380	580,434	66,032	14	555,229	63,604	529,860	61,100
15	647,903	78,448	621,103	75,755	15	594,121	72,969	566,967	70,094
16	690,172	89,198	661,611	86,133	16	632,857	82,965	603,921	79,696
17	732,262	100,624	701,945	97,166	17	671,425	93,592	640,713	89,903
18	774,163	112,725	742,095	108,851	18	709,815	104,844	677,333	100,711
19	815,866	125,498	782,051	121,183	19	748,016	116,721	713,770	112,119
20	857,357	138,939	821,802	134,160	20	786,018	129,220	750,016	124,123
21	898,627	153,045	861,338	147,780	21	823,812	142,335	786,059	136,720
22	939,664	167,812	900,649	162,037	22	861,387	156,065	821,890	149,905
23	980,459	183,237	939,723	176,927	23	898,734	170,405	857,502	163,678
24	1,021,002	199,314	978,552	192,449	24	935,840	185,352	892,882	178,031
25	1,061,281	216,041	1,017,124	208,597	25	972,700	200,901	928,022	192,964
26	1,101,286	233,413	1,055,429	225,367	26	1,009,301	217,049	962,913	208,471
27	1,141,007	251,426	1,093,459	242,754	27	1,045,634	233,791	997,545	224,548
28	1,180,432	270,075	1,131,202	260,755	28	1,081,689	251,123	1,031,908	241,190
29	1,219,553	289,355	1,168,649	279,364	29	1,117,458	269,039	1,065,994	258,393
30	1,258,360	309,260	1,205,791	298,576	30	1,152,930	287,536	1,099,793	276,155

Longitude.	Latitude 71°.		Latitude 72°.		Longitude.	Latitude 71°.		Latitude 72°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	36,345	300	34,498	286	16	574,810	76,330	545,532	72,871
2	72,680	1,200	68,987	1,145	17	609,817	86,105	578,746	82,203
3	108,995	2,699	103,457	2,576	18	644,658	96,456	611,800	92,084
4	145,280	4,797	137,898	4,580	19	679,324	107,380	644,686	102,513
5	181,526	7,493	172,301	7,154	20	713,803	118,876	677,394	113,485
6	217,723	10,788	206,657	10,299	21	748,090	130,939	709,915	124,999
7	253,860	14,679	240,956	14,015	22	782,172	143,565	742,241	137,052
8	289,928	19,166	275,189	18,298	23	816,042	156,753	774,362	149,639
9	325,917	24,247	309,345	23,150	24	849,688	170,497	806,270	162,758
10	361,818	29,922	343,417	28,568	25	883,104	184,795	837,956	176,404
11	397,619	36,189	377,394	34,550	26	916,279	199,643	869,411	190,575
12	433,313	43,045	411,266	41,096	27	949,205	215,036	900,626	205,266
13	468,888	50,489	445,026	48,203	28	981,872	230,970	931,593	220,473
14	504,337	58,520	478,663	55,869	29	1,014,272	247,441	962,304	236,192
15	539,646	67,134	512,168	64,093	30	1,046,395	264,444	992,749	252,418

II.—*Table of co-ordinates*—Continued.

Longitude.	Latitude 73°.		Latitude 74°.		Longitude.	Latitude 75°.		Latitude 76°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	32,641	272	30,774	258	1	28,897	244	27,011	229
2	65,273	1,090	61,539	1,033	2	57,786	974	54,015	915
3	97,888	2,451	92,287	2,323	3	86,658	2,192	81,003	2,058
4	130,474	4,357	123,009	4,129	4	115,506	3,896	107,967	3,658
5	163,024	6,806	153,696	6,450	5	144,321	6,086	134,901	5,715
6	195,529	9,799	184,340	9,286	6	173,095	8,762	161,796	8,227
7	227,979	13,333	214,932	12,635	7	201,819	11,922	188,645	11,194
8	260,366	17,409	245,464	16,498	8	230,487	15,566	215,439	14,616
9	292,681	22,024	275,927	20,871	9	259,089	19,693	242,173	18,491
10	324,913	27,178	306,311	25,756	10	287,617	24,302	268,836	22,818
11	357,056	32,869	336,610	31,149	11	316,064	29,390	295,422	27,596
12	389,099	39,097	366,814	37,050	12	344,420	34,958	321,924	32,823
13	421,033	45,858	396,914	43,457	13	372,661	41,003	348,333	38,499
14	452,850	53,151	426,903	50,367	14	400,832	47,523	374,642	44,621
15	484,541	60,974	456,772	57,781	15	428,871	54,517	400,844	51,187
16	516,097	69,325	486,513	65,693	16	456,787	61,983	426,931	58,197
17	547,510	78,201	516,116	74,104	17	484,575	69,918	452,895	65,647
18	578,769	87,600	545,574	83,011	18	512,224	78,320	478,730	73,535
19	609,868	97,520	574,878	92,409	19	539,728	87,188	504,428	81,860
20	640,796	107,958	604,020	102,299	20	567,079	96,517	529,980	90,620
21	671,546	118,910	632,994	112,676	21	594,268	106,307	555,381	99,810
22	702,109	130,374	661,788	123,538	22	621,288	116,554	580,622	109,429
23	732,476	142,346	690,396	134,881	23	648,133	127,254	605,697	119,475
24	762,640	154,824	718,810	146,703	24	674,792	138,406	630,598	129,943
25	792,591	167,083	747,022	158,999	25	701,260	150,006	655,318	140,831
26	822,321	181,280	775,023	171,767	26	727,529	162,034	679,851	152,138
27	851,822	195,252	802,806	185,003	27	753,591	174,534	704,189	163,857
28	881,086	209,714	830,363	198,704	28	779,438	187,457	728,324	175,987
29	910,104	224,662	857,686	212,865	29	805,065	200,813	752,251	188,524
30	938,869	240,093	884,769	227,481	30	830,462	214,600	775,962	201,464

Longitude.	Latitude 77°.		Latitude 78°.		Longitude.	Latitude 77°.		Latitude 78°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	25,117	214	23,215	198	16	396,951	54,340	366,857	50,418
2	50,227	854	46,423	793	17	421,086	61,296	389,158	56,871
3	75,322	1,922	69,618	1,783	18	445,101	68,661	411,346	63,704
4	100,395	3,416	92,792	3,170	19	468,985	76,434	433,413	70,915
5	125,440	5,336	115,940	4,951	20	492,735	84,611	455,354	78,508
6	150,448	7,682	139,054	7,128	21	516,342	93,192	477,163	86,462
7	175,413	10,453	162,127	9,699	22	539,799	102,173	498,833	94,793
8	200,327	13,648	185,153	12,663	23	563,101	111,551	520,357	103,493
9	225,183	17,266	208,125	16,020	24	586,240	121,324	541,729	112,559
10	249,973	21,307	231,036	19,769	25	609,209	131,489	562,944	121,989
11	274,692	25,768	253,879	23,908	26	632,002	142,043	583,994	131,779
12	299,331	30,649	276,650	28,437	27	654,612	152,984	604,874	141,928
13	323,884	35,948	299,339	33,354	28	677,033	164,306	625,579	152,431
14	348,342	41,664	321,941	38,657	29	699,258	176,009	646,100	163,286
15	372,701	47,796	344,449	44,346	30	721,281	188,089	666,434	174,490

II.—*Table of co-ordinates*—Continued.

Longitude.	Latitude 79°.		Latitude 80°.		Longitude.	Latitude 81°.		Latitude 82°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	21,306	183	19,390	167	1	17,468	151	15,541	134
2	42,605	730	38,774	667	2	34,931	602	31,077	537
3	63,893	1,642	58,147	1,500	3	52,384	1,355	46,605	1,209
4	85,161	2,919	77,503	2,665	4	69,821	2,408	62,118	2,148
5	106,404	4,560	96,836	4,164	5	87,238	3,762	77,612	3,356
6	127,617	6,565	116,140	5,994	6	104,628	5,416	93,084	4,831
7	148,791	8,933	135,410	8,156	7	121,988	7,369	108,528	6,573
8	169,922	11,663	154,640	10,649	8	139,310	9,621	123,939	8,582
9	191,003	14,755	173,824	13,472	9	156,592	12,172	139,313	10,857
10	212,029	18,208	192,957	16,624	10	173,828	15,020	154,646	13,397
11	232,991	22,020	212,033	20,104	11	191,011	18,164	169,932	16,202
12	253,886	26,191	231,046	23,912	12	208,138	21,605	185,168	19,271
13	274,706	30,719	249,991	28,047	13	225,203	25,340	200,348	22,603
14	295,445	35,603	268,862	32,506	14	242,201	29,369	215,469	26,196
15	316,098	40,842	287,654	37,289	15	259,127	33,690	230,525	30,050
16	336,657	46,434	306,361	42,394	16	275,976	38,302	245,512	34,164
17	357,118	52,377	324,977	47,820	17	292,743	43,204	260,426	38,537
18	377,475	58,670	343,497	53,565	18	309,423	48,395	275,262	43,166
19	397,720	65,311	361,916	59,627	19	326,011	53,872	290,016	48,051
20	417,849	72,297	380,228	66,005	20	342,503	59,634	304,683	53,191
21	437,854	79,628	398,427	72,697	21	358,892	65,679	319,260	58,582
22	457,732	87,299	416,509	79,701	22	375,175	72,007	333,740	64,226
23	477,475	95,311	434,468	87,014	23	391,346	78,614	348,122	70,118
24	497,078	103,660	452,298	94,636	24	407,401	85,498	362,399	76,259
25	516,535	112,343	469,995	102,562	25	423,335	92,659	376,568	82,645
26	535,840	121,358	487,553	110,792	26	439,143	100,093	390,624	89,275
27	554,989	130,703	504,967	119,322	27	454,821	107,799	404,564	96,147
28	573,974	140,374	522,231	128,150	28	470,363	115,773	418,385	103,258
29	592,791	150,369	539,342	137,273	29	485,766	124,014	432,077	110,608
30	611,433	160,685	556,292	146,689	30	501,024	132,520	445,642	118,193

Longitude.	Latitude 83°.		Latitude 84°.		Longitude.	Latitude 83°.		Latitude 84°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	13,609	118	11,673	101	16	214,978	29,985	184,381	25,769
2	27,214	471	23,342	405	17	228,035	33,822	195,579	29,067
3	40,811	1,061	35,004	912	18	241,024	37,885	206,717	32,558
4	54,395	1,885	46,656	1,620	19	253,940	42,173	217,794	36,243
5	67,963	2,945	58,293	2,531	20	266,780	46,683	228,805	40,119
6	81,511	4,240	69,913	3,644	21	279,541	51,415	239,747	44,185
7	95,035	5,769	81,512	4,958	22	292,217	56,367	250,616	48,441
8	108,529	7,532	93,086	6,473	23	304,806	61,539	261,410	52,885
9	121,992	9,529	104,633	8,190	24	317,303	66,927	272,126	57,516
10	135,417	11,759	116,148	10,106	25	329,706	72,532	282,759	62,332
11	148,802	14,221	127,628	12,221	26	342,008	78,350	293,308	67,331
12	162,142	16,914	139,069	14,536	27	354,209	84,380	303,767	72,514
13	175,434	19,838	150,468	17,049	28	366,303	90,621	314,136	77,876
14	188,673	22,992	161,822	19,759	29	378,287	97,071	324,410	83,418
15	201,856	26,374	173,128	22,666	30	390,158	103,727	334,586	89,138

II.—*Table of co-ordinates*—Continued.

Longitude.	Latitude 85°.		Latitude 86°.		Longitude.	Latitude 87°.		Latitude 88°.	
	x.	*y.*	*x.*	*y.*		*x.*	*y.*	*x.*	*y.*
°	*Metres.*	*Metres.*	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	*Metres.*	*Metres.*
1	9,733	85	7,790	68	1	5,845	51	3,897	34
2	19,463	338	15,577	271	2	11,687	204	7,794	136
3	29,187	761	23,360	610	3	17,526	458	11,687	306
4	38,902	1,353	31,136	1,085	4	23,360	815	15,578	544
5	48,605	2,114	38,902	1,694	5	29,187	1,273	19,463	849
6	58,294	3,043	46,657	2,439	6	35,005	1,832	23,343	1,223
7	67,965	4,141	54,397	3,319	7	40,812	2,493	27,215	1.664
8	77,616	5,407	62,121	4,333	8	46,607	3,255	31,079	2,172
9	87,243	6,840	69,826	5,482	9	52,388	4,117	34,934	2,748
10	96,843	8,440	77,510	6,765	10	58,153	5,081	38,778	3,391
11	106,415	10,207	85,170	8,181	11	63,900	6,144	42,611	4,100
12	115,954	12,141	92,805	9,730	12	69,628	7,308	46,430	4,877
13	125,458	14,239	100,411	11,412	13	75,334	8,571	50,235	5,720
14	134,924	16,503	107,987	13,226	14	81,018	9,934	54,025	6,629
15	144,350	18,931	115,530	15,172	15	86,677	11,395	57,799	7,605
16	153,732	21,522	123,038	17,249	16	92,310	12,955	61,555	8,646
17	163,067	24,277	130,509	19,457	17	97,914	14,613	65,292	9,752
18	172,353	27,192	137,941	21,794	18	103,489	16,368	69,009	10,923
19	181,587	30,270	145,330	24,260	19	109,033	18,220	72,705	12,159
20	190,766	33,507	152,676	26,854	20	114,543	20,169	76,380	13,459
21	199,888	36,903	159,975	29,576	21	120,019	22,213	80,031	14,824
22	208,949	40,457	167,226	32,424	22	125,458	24,352	83,657	16,251
23	217,947	44,169	174,426	35,399	23	130,859	26,586	87,258	17,742
24	226,879	48,036	181,573	38,498	24	136,221	28,914	90,833	19,295
25	235,742	52,058	188,665	41,721	25	141,540	31,334	94,380	20,910
26	244,534	56,233	195,700	45,067	26	146,817	33,847	97,898	22,587
27	253,252	60,560	202,675	48,535	27	152,050	36,452	101,387	24,325
28	261,894	65,039	209.590	52,124	28	157,236	39,147	104,845	26,124
29	270,456	69,667	216,440	55,833	29	162,374	41,933	108,270	27,983
30	278,937	74,443	223,225	59,661	30	167,463	44,807	111,663	29,901

Longitude.	Latitude 89°.		Longitude.	Latitude 89°.		Longitude.	Latitude 89°.		Longitude.	Latitude 89°.	
	x.	*y.*		*x.*	*y.*		*x.*	*y.*		*x.*	*y.*
°	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*	°	*Metres.*	*Metres.*
1	1,949	17	9	17,470	1,375	16	30,782	4,325	23	43,635	8,876
2	3,897	68	10	19,392	1,696	17	32,651	4,879	24	45,422	9,653
3	5,845	153				18	34,509	5,465	25	47,196	10,461
4	7,790	272	11	21,308	2,051	19	36,358	6,083	26	48,955	11,300
5	9,733	425	12	23,218	2,440	20	38,195	6,734	27	50,700	12,170
6	11,673	612	13	25,121	2,862				28	52,428	13,070
7	13,610	832	14	27,016	3,317	21	40,021	7,416	29	54,141	14,000
8	15,542	1,087	15	28,904	3,805	22	41,834	8,130	30	55,838	14,959

TABLE III.—*Length in metres of* 1° *of latitude and longitude.*

Lat.	1° of latitude.	1° of longitude.	Radius of parallel.	θ for 10°.		
°	*Metres.*	*Metres.*	*Metres.*	°	′	″
55	111,310.7	63,986.3	4,475,535	8	11	29.5
56	111,328.9	62,385.1	4,311,509	8	17	25.4
57	111,346.9	60,764.7	4,151,287	8	23	12.1
58	111,364.6	59,125.6	3,994,639	8	28	49.7
59	111,382.0	57,468.2	3,841,358	8	34	18.0
60	111,399.1	55,793.1	3,691,243	8	39	36.9
61	111,415.9	54,100.8	3,544,108	8	44	46.3
62	111,432.3	52,391.8	3,399,779	8	49	46.1
63	111,448.4	50,666.6	3,258,090	8	54	36.2
64	111,464.0	48,925.7	3,118,884	8	59	16.6
65	111,479.2	47,169.7	2,982,014	9	3	47.1
66	111,494.0	45,399.1	2,847,341	9	8	7.6
67	111,508.3	43,614.4	2,714,732	9	12	18.2
68	111,522.2	41,816.3	2,584,060	9	16	18.6
69	111,535.5	40,005.2	2,455,205	9	20	8.9
70	111,548.4	38,181.8	2,328,053	9	23	48.9
71	111,560.8	36,346.5	2,202,496	9	27	18.7
72	111,572.6	34,499.9	2,078,425	9	30	38.0
73	111,583.8	32,642.7	1,955,744	9	33	47.0
74	111,594.4	30,775.3	1,834,354	9	36	45.4
75	111,604.5	28,898.4	1,714,164	9	39	33.3
76	111,614.1	27,012.5	1,595,083	9	42	10.6
77	111,623.0	25,118.2	1,477,025	9	44	37.3
78	111,631.3	23,216.2	1,359,907	9	46	53.3
79	111,639.0	21,306.9	1,243,646	9	48	58.6
80	111,646.1	19,391.0	1,128,165	9	50	53.1
81	111,652.5	17,469.2	1,013,385	9	52	36.8
82	111,658.2	15,541.8	899,232	9	54	9.7
83	111,663.2	13,609.7	785,633	9	55	31.7
84	111,667.6	11,673.3	672,515	9	56	42.8
85	111,671.4	9,733.3	559,807	9	57	43.0
86	111,674.8	7,790.3	447,439	9	58	32.3
87	111,676.9	5,844.8	335,343	9	59	10.7
88	111,678.6	3,897.6	223,450	9	59	38.1
89	111,679.6	1,949.1	111,691	9	59	54.5

APPENDIX No. 21.

RESULTS OF THE PRIMARY TRIANGULATION OF THE COAST OF NEW ENGLAND, FROM THE NORTH-EASTERN BOUNDARY TO THE VICINITY OF NEW YORK.

The primary triangulation of that portion of the coast of the United States which extends from the Hudson to the St. Croix river was completed during the summer of 1865, by the occupation of stations West Hills and Ruland, on Long Island. It has been executed between the years 1844 and 1865 by the party of the Superintendent, and the observations have been made in great part by Prof. Bache himself, or under his immediate direction, by the assistants in his party. Near each extremity of this great chain of triangles, extending over four hundred and eighty miles, (see Sketch No. 1,) a base line has been measured; a third one forms part of the branch stretching from the direct chain over to Cape Cod and Nantucket, a distance of nearly one hundred and forty miles.

The most southern one of these base lines was measured in 1834, by the first Superintendent, Prof. F. R. Hassler, on Fire Island beach; the intermediate one, in Massachusetts, on the line of the Boston and Providence railroad, was measured in 1844, by Assistant Edmund Blunt; the most northern one in 1857, by the present Superintendent, Prof. A. D. Bache, with different bars and apparatus. The verifications obtained are thus peculiarly independent of each other, and the estimate of the accuracy of the results which is arrived at may be received with confidence.

In the following pages the probable error of each of the base lines is first estimated, as arising from the three principal sources of uncertainty, viz: first, the comparison of the measuring rods with the standard metre; second, the measurement proper, or the successive contacts of the apparatus; and third, the ascertainment of the actual temperature of the bars, during measurement or comparison, by means of thermometers, which themselves are effected by some degree of uncertainty.

Next, the methods of adjustment of the triangulation, without reference to the length of the base lines, are explained, and comparisons are given between the measured length of each base line and that deduced from each of the others through the triangulation. Here we find that the agreements are within the limits of the assigned probable uncertainties.

The mode is next explained in which the three sets of values thus obtained are brought together, without disturbing the perfect adjustment of the geometrical figure, and the method adopted according to which the uncertainties of the final values have been computed is set forth. A table giving the observed and adjusted angles and resulting distances for the whole chain of triangles concludes the paper.

The discussions and computations have been made by Assistant C. A. Schott, in consultation with and under the immediate direction of Assistant J. E. Hilgard, in charge of the office.

Length and accuracy of the Fire Island base line.—The site of this base is on the southern shore of Long Island, New York, on the Fire Island beach, between the Great South bay and the Atlantic ocean, and nearly fifty miles east of New York bay. The measurement was made in August, September, and October, 1834, under the direction of F. R. Hassler, then Superintendent of the Coast Survey, and by means of an apparatus of his own design. For a full description of this base apparatus, as constructed and used by Mr. Hassler, the reader is referred to the transactions of the American Philosophical Society, Philadelphia, vol. II, new series, 1825, pp. 273–286. This apparatus consisted essentially of four two-metre bars, making a total length of eight metres, placed in contact with each other in a wooden box, and of micrometer microscopes mounted on stands provided with movements by which the wires could be brought over the ends to the bars projecting from the box. The forward microscope wire being brought into optical contact with the end of the bars, the latter was next carried forward and its rear end brought under the same microscope, and thus the operation was repeated.

The distance between the monuments marking the ends of the base was not measured directly, but in order to have the advantage of the level beach a line starting from the western terminus and running a short distance to the southward of the eastern terminus was measured instead, and referred to the line between the monuments by means of suitable angular and linear measures. These monuments are $8\frac{3}{4}$ statute miles apart.

The four iron double metre bars, A, B, C, D, were compared by Mr. Hassler with the 84-inch Troughton scale of brass, in May, 1834, and in March, 1835. Their combined length, derived through the ascertained relation of the Troughton scale to the committee metre, (the adopted unit of length,) equals 8.0000414 metres at 32° Fahr. In 1835, after the above comparisons had been made, the ends of the bars A and D were found rusted, and after cleaning the combined length of the bars was found 7.9999764 at 32°. New comparisons

with the Bessel contact comparator, made in 1844 and 1845, gave the result 7.9998716 at 32°. This apparent shortening of the bars ten years after the base measure cannot fully be accounted for. Part of it may be due to corrosion, but it is, doubtless, principally owing to different methods of comparison, one being optical, with a scale of different metal, the other by contact with a bar of the same metal and cross-section. It has therefore been considered safest to adhere to the old comparison of 1834 and 1835, between which dates the base was measured, especially since the base measure itself employs optical means.

The temperature of the bars during the base measure was ascertained by means of eight thermometers, two to each bar. The comparisons with a standard thermometer gave their average index correction $+0^\circ.09$ at 32°, and their average graduation error $-0^\circ.46$ at 68°; mean temperature of bars, 80°.36; correction for graduation error, —0.46; hence the excess of the mean temperature during measure above the temperature of melting ice $=47^\circ.9$. Mr. Hassler's determination of the coefficient of expansion of iron (Transactions of the American Philosophical Society, vol. I, new series, p. 224) gave the value 0.000006963535, which was used for the reduction of temperature. For the reduction to the sea level we assume the average elevation of the bars above the mean or half-tide level of the ocean to be $2^m.75$ We therefore find for the length of the line measured directly the following data:

		Metres.
1725 boxes at 8 metres		13800
Excess of each over 8 metres, or 1725×0.0000414	+	0.0714
Correction for expansion of bars for 47°.9	+	4.6031
Correction for inclination	—	0.2055
Reduction to half-tide level of ocean	—	0.0060
Resulting length		13804.4630
Additional distance, derived from several linear and angular measures		254.5079
Total length between the monuments		14058.9709

In order to estimate the accuracy of this value we must first form an estimate of the probable error of the principal distance. The probable error in the length of A+B+C+D has been deduced from the differences in the comparisons of 1834 and 1835, and found ±0.0000242 metres; in 1725 boxes this will therefore amount to ±0.0417 metres.

Whenever the temperature of the air is rising, the temperature indicated by the thermometers will be higher than that of the bars; in the contrary case it will be lower; consequently, if the number of boxes placed during rising temperature equals the number placed during falling temperature, the length of the base would not be materially in error from this cause, provided the temperature changes keep within moderate limits. Now we find about 455 boxes placed with rising temperature, 553 with stationary, and 717 with falling temperature. The difference in the first and last case is 262 boxes, and if we suppose the difference in temperature between bar and air to amount to 2°, the error in the length of the line would amount to 0.029 metre, (too short.) We may therefore allow an uncertainty of at least ±0.029 metre in the length of the base. Besides, the graduation error of the thermometer must be estimated at $\pm\frac{1}{4}$ of a degree, which introduces a corresponding probable uncertainty of ±0.023 metre in the total length. These two uncertainties combined give ±0.0370 metre.

The probable error arising from the instability of the microscopes may be safely assumed as certainly less than $\frac{1}{200}$ of an inch, or ±0.000127 metre; the corresponding effect on the length of the base is therefore less than ±0.0053 metre.

These three sources of error make up the principal part of the uncertainty in the length of the measured line; other smaller uncertainties will therefore be included in the combination

$$\sqrt{(0.0417)^2+(0.0370)^2+(0.0053)^2}=\pm0.0560 \text{ metre.}$$

The probable error of the additional distance of 254.5079 metres is found to be ±0.017, from the adjustment of the measured distances and angles, which were not observed with extreme care. Combining this with that above found for the longer line, we obtain as the probable uncertainty of the base line between the monuments $\sqrt{(0.056)^2+(0.017)^2}=\pm0.0585$. This is equal to ±2.30 inches, or to $\frac{1}{240270}$ of the length. The corresponding value in the logarithm of the base may be found by the expression $\pm\frac{\Delta l M}{l}=\pm0.0000018\ 072$

where M= modulus of common logarithms, l the length of the base, and Δl its probable error. We have consequently the following value for the resulting length of the Fire Island base line:

$$14058.9709 \pm 0.0585 \text{ metres,}$$

and its logarithm,

$$\begin{array}{r} 4.1479535\ 320 \\ \pm \quad\quad 18\ 072. \end{array}$$

Length and accuracy of the Massachusetts base line.—The site of the Massachusetts base is on the Boston and Providence railroad, Bristol county, Massachusetts, and within a few miles of Providence, Rhode Island. The base was measured in September, October, and November, 1844, by Assistant Edmund Blunt, with the same apparatus as had been previously employed at Fire Island. Its general direction is north-easterly, with a length of nearly 10¾ miles between the terminal monuments.

The comparisons of the four double-metre bars with the standard (committee) metre, by means of Bessel's contact comparator, in 1844 and '45, gave their combined length A+B+C+D=7.99987165 metres at 32°, as above stated in the account of the Fire Island base.

The mean temperature of the bars during the measurement, corrected for graduation error, was 58°.85; hence the excess of temperature above that of melting ice =26°.85. The coefficient of expansion remains as before. From the levels of the railroad track and of base line the average elevation above half-tide at Boston harbor is 44.83 metres, allowing for elevation of instrument above ground. We have consequently the resulting length of the base, as follows:

		Metres.
2165 boxes at 8 metres		17320
Defect of each on 8 metres, or 2165×0.00012835	—	0.2779
Correction for expansion, or excess of temperature over 32°	+	3.2383
Correction for inclination	—	0.5629
Bars A+D (at 32°) at northeast end	+	3.9999
Their correction for 10° of temperature below 32°	—	0.0003
Additional scale measure	+	0.1012
Reduction to the half-tide level of the ocean	—	0.1220
Resulting length		17326.3763

In forming an estimate of the accuracy of this value, we consider first the probable error of the assigned length of the four bars, derived from their comparisons with the standard metre. This is found to be ±0 0000055; the probable error in 2165 boxes is therefore ±0.0119 metre.

With respect to temperature, we have about 702 boxes laid with rising and 579 boxes with falling temperature; for the rest the temperature was stationary. There are, therefore, 123 boxes uncompensated, and, making the same assumptions as for the preceding case, the uncertainty in the length of the base cannot be taken less than ±0.0137. Combining this with the graduation uncertainty ±0.0302, we find the probable error ±0.0332 metre, arising from the temperature corrections.

The probable error from instability of microscopes, as stated for the preceding base line, cannot exceed $\pm 0.000127\sqrt{2165} = \pm 0.0059$ metre.

Putting together these three principal probable errors, that of the assigned length of the base becomes $\sqrt{(0.0332)^2+(0.0119)^2+(0.0059)^2} = \pm 0.0358$ metre, $= \pm 1.41$ inches, equal $\frac{1}{483980}$ of the length; the corresponding value in the logarithm is ± 8 973 in units of the seventh place of decimals. We have, therefore, the following value for the resulting length of the Massachusetts base:

$$17326.3763 \pm 0.0358 \text{ metres,}$$

and its logarithm,

$$\begin{array}{r} 4.2387077\ 423 \\ \pm \quad\quad 8\ 973 \end{array}$$

Length and accuracy of the Epping base line.—The site of the base is on Epping plains, near Cherryfield, Washington county, Maine. It was selected in 1853, by C. O. Boutelle and Major H. Prince, U. S. A., assistants, and the measurement was made in July and August, 1857, by Prof. A. D. Bache, with the compensating base apparatus with contact level, designed by himself, and fully described and figured in Coast Survey Report of 1854, Appendix No. 35. The Epping base is the sixth primary line measured with this

new compensation apparatus. The distance between the base monuments is not quite $5\frac{1}{2}$ statute miles. The length of the compensating tubes Nos. 1 and 2 was compared with the 6-metre iron standard directly, before, and again immediately after the base measure. The resulting length and coefficient of expansion of this standard is given in Coast Survey Report of 1862, Appendix No. 26, by J. E. Hilgard. Saxton's reflecting comparator was supplied with a new scale, also a new abutting screw, with its head divided into 100 divisions, and the mirror was supplied with a barrel, producing equal angular increments for equal linear increments. One turn of the screw was found =357.11 scale divisions, and one scale division =0.000001360 metre. Taking alternate means to allow for progressive changes of temperature, and expansion of bar, three sets of 23 comparisons of length of the standard and tube No. 1, July 16, 17, at the mean temperature 65°.00, gave: tube No. 1, shorter than standard 1300.4 ± 2.0 divisions; and three sets of 20 comparisons with the other tube gave: tube No. 2, shorter than standard, at the above temperature, 1088.7 ± 2.2 divisions. After the base measure, four sets of 27 comparisons, August 6, 7, gave: tube No. 1, shorter than standard 1411.8 ± 3.3 divisions, at 69°.86; the same number of sets and 23 comparisons gave: tube No. 2, shorter than standard, 1195.3 ± 2.9 divisions, at the temperature 69°.88. Combining these results, without regard to their probable error, we find tube No. 1 shorter than standard 0 0018443 metre ± 0 0000024, and tube No. 2 shorter than standard 0.0015531 metre ± 0.0000024; the former at 67°.43, the latter at 67°.44. The length of the standard being 5.9999407 metres ± 0.0000009 at 32°, and its coefficient of expansion $0.00000641 \pm 0.00000002$, its length at the above temperatures will be 6.0013033 ± 0.0000042 and 6.0013037 ± 0.0000042, respectively, and the length of the tubes becomes—

Tube No. 1 =5.9994590 metres ± 0.0000049.
Tube No. 2 =5 9997506 metres ± 0.0000049.

The probable errors given here are those resulting from the comparisons alone; but some allowance is to be made for the circumstances that the temperature of the standard bar, as indicated by thermometers in air, may not be the same as that of the metal, though the thermometers were in contact with it and had only their stems exposed. This difference depends mainly on the rate of change. During the comparisons preceding the base measurement, the temperature may be said to have been falling in nine cases, rising in seven, and to have remained nearly stationary in seven cases. The comparisons following the measurement were made with about an equal number of cases of rising and of falling temperature. To obtain an estimate of the probable amount of a difference between the temperature of the metal and the air, we have recourse to the small changes in the length of the tubes, noticed at different times. There are indications of a diminution in the length of each tube shortly after they had been made, but they afterwards assumed a more permanent and nearly unchangeable condition. Whatever small differences in length now appear, from comparisons with the standard in connection with the several base measurements, must mainly be attributed to the difficulty of ascertaining the true temperature of the standard bar. Other smaller differences may be due to a settling and wear of the various parts of the apparatus itself. Between November, 1848 and 1857, the variations in the length of each tube, from six sets of numerous comparisons, furnish the probable error of any assigned length of tube No. 1, about, ± 0.0000235, and of tube No. 2, about, ± 0.0000138. The average amount ± 0.0000193 corresponds to a variation of $\pm 0°.5$ in temperature, if we throw the whole of the uncertainties upon the temperature indications, and if we suppose the tubes to be of invariable lengths. Assuming $\pm 0°.25$ as limit of the index error of the thermometers, or temperature uncertainty, its effect upon the length of a tube is ± 0.0000097 metre. Combining this value with that found above from the direct comparison with the standard on Epping plains, the total probable error of the assigned length of a mean tube becomes—

$$\sqrt{(0.0000097)^2+(0.0000049)^2} = \pm 0.0000109 \text{ metre.}$$

The probable error in 1453 tubes is ± 0.0158 metre, which may be taken to include all smaller uncertainties in the measure of the base.

The compensation of the tubes was most thoroughly tested at the Coast Survey office, under such favorable circumstances as cannot be commanded while the apparatus is in the field. It was found perfect for a considerable range of temperature, as well as for changing temperatures. Many comparisons of the tubes with the standard bar, made in the field and in connection with the base measures, would indicate sometimes a small under-compensation, at other times a small over-compensation; these results are, however, affected with a residual error arising from a want of stationary temperature of the standard bar during these comparisons, and without which no comparison of length can be satisfactory. No correction for differential expansion of the tubes need therefore be applied, but the principal portion of the probable error assigned above to the

length of the base will remain due to the uncertainty of ascertaining the actual temperature of the bar. The thermometer scales were compared with that of a standard instrument. In the present case the temperature during the base measure was 74°.1, and during the comparisons 67°.5.

The correction for the observed inclinations of the measuring tubes amounts in the aggregate to 2.8040 metres. At the east end of the base the distance between the end of the tube 1453 and the terminal point of the base was measured with the brass Lenoir metre at a temperature of 66°.1 Fah. The distance was measured twice and reduced to terms of the standard metre.

For the reduction to the surface of the sea the levels gave the mean elevation of the tubes above the half-tide level of the ocean =76.45 metres. In latitude 44° 42′ and in azimuth E. 16° S. the earth's radius of curvature becomes 6386310 metres, (using Bessel's ellipsoid;) hence the correction to refer the measured length to the ocean level =—0.1044 metre. The length of the base becomes consequently:

1452 tubes of mean length	8712 — 0.5738 ± 0.0158 metres.
Odd tube, No. 1 bis	6 — 0.0006
Correction for inclination of tubes	0 — 2.8040
Defect of tube at east end	2 — 0.5750
Reduction to half-tide level of ocean	0 — 0.1044
	8720 — 4.0578
Resulting length of base	8715.9422 metres ± 0.0158

We may take this probable error to include that arising from making of contacts of tubes. The value ±0.0158 metre equals ±0.62 inch, nearly equal to $\pm\frac{1}{551650}$ of the length. The corresponding value in the logarithm of the base is 0.0000007 873. We have consequently the following value for the resulting length of the Epping base:

$$8715.9422 \pm 0.0158 \text{ metres,}$$

and its logarithm,

$$\begin{array}{r} 3.9403143\ 416 \\ \pm \qquad\quad 7\ 873 \end{array}$$

The estimate of the accuracy of the measure here arrived at for each of the three base lines can only be regarded as approximate, since no special observations were made for the purpose. The accuracy being inversely proportional to the probable error, here expressed in parts of the length, the accuracy of the measure of the Fire Island, Massachusetts, and Epping base lines is nearly proportional to the numbers four, eight, and nine.

Geodetic connection of the three primary base lines in Maine, Massachusetts, and New York, their degree of accordance and resulting accuracy of the primary triangulation intervening.—The object of this paper is a double one: first, to complete the exposition of the methods of reduction employed in the principal triangulation, which had been commenced in Coast Survey Report of 1854, Appendix No. 33, (S,) and Coast Survey Report of 1864, Appendix No. 14; and secondly, to exhibit, in advance of the regular publication of the records and results of the survey, the degree of accuracy reached in the primary operations in the eastern States, both in linear and angular measures.

The discussion and resulting length and accuracy of the measures of the base lines has already been given, as well as the method of adjustment of the angular measures of a primary triangulation. It remains to exhibit the manner in which the measured lengths of the bases have been made comparable and the resulting accuracy of the intervening triangle sides.

The following general scheme for the connection of the base lines and deduction of length of sides has been adopted and carried out: The whole was conceived to consist of three branches, one for each base line, and proceeding therefrom to a line in common or to a general junction, which is the line Monadnock—Gunstock· Adjusting each branch, three independent values for the length and probable error of this junction line will be obtained, and the weighted mean will be the most probable value assignable. The probable errors involved will include the effect of the probable error of the measure of the respective bases and the probable errors of the respective angles of the intervening triangulation. The length of each base, *as measured*, is to be preserved, as well as the weighted mean length of the junction. The least-square adjustment of each branch will then be repeated, with an *additional* equation, *fixing* the ratio of the length of the base to the junction. Introducing this equation, if we start in our computation of lengths of triangle sides from any one of the measured base lines, we shall, as we recede from it, obtain a proportional amount of the influence of the measure of the other two lines as we approach them, and finally reaching one or the other, the effect of that base from which

we had set out is lost. Each distance, moreover, will have assigned to it its most probable value; we shall have no discrepancy whatever in the geometrical figure of the triangulation; the number of equations will keep within manageable bounds, and the resulting values of angles and sides will have very nearly the same probability as those derived from a theoretically perfect solution.

Below is given, in tabular form, a statement of the principal data and results of the adjustment of the upper, (Epping,) middle, (Massachusetts,) and lower (Fire Island) branches of the triangulation, together with corresponding values of the special work of the Epping base connection:

Part.	Number of:	Conditional equations of—		Equations of correlatives.	Normal equations.
		Angles.	Sides.		
I	Epping connection	21	14	58	35
II	Upper branch	20	8	66	28
III	Middle branch	18	7	60	25
IV	Lower branch	22	8	74	30

The resulting length of the junction "Monadnock—Gunstock" from each of the base measures and computed through the triangulation is as follows:

	Length of junction, in metres.	Intervening distances, in miles.
From Epping base	94469.215	250
From Massachusetts base	94468.384	88
From Fire Island base	94468.757	205

The distances between the base lines through the axis of the triangulation are:

	Miles.
Epping to Massachusetts	295
Massachusetts to Fire Island	230
Epping to Fire Island, direct	430
The length of the junction is	58 70

If we desire a direct comparison of the base lines as measured and computed through the triangulation, we find:

	m.		*m.*		*m.*
Epping base, measured	8715.942	Massachusetts base, meas'd.	17326.376	Fire Island base, measured	14058.971
Epping base, from Massachusetts base	8715.865	Massachusetts base, from Epping base	17326.528	Fire Island base, from Epping base	14059.039
Epping base, from Fire Island base	8715.900	Massachusetts base, from Fire Island base	17326.445	Fire Island base, from Massachusetts base	14058.916

We now proceed to the method of computation of the probable uncertainty in the sides of the triangulation. The strict application of the method of least-squares in connection with the computation of probable errors of the adjusted parts of a triangulation becomes, in our case, impracticable from its laborious nature, and a shorter method must be sought and followed, which, while it is a sufficient approximation to the truth, yet furnishes us with all desirable data to judge of the accuracy of our results.

The greater the number of conditions in the geometrical figure the greater, other things being equal, will be the final accuracy of the assigned length of any side. If we had but a single chain of triangles, without conditions, between two base lines, we might easily compute the probable error of the second from the first by proceeding from triangle to triangle with the known values of all distances, the probable error of the base measure and the probable error of each measured angle, by the ordinary method, presently to be shown. It has been found by experience that a satisfactory and simple determination of the probable error of any side, depending

upon a measured base and a series of measured directions of known accuracy, can be obtained by regarding the intervening triangulation as composed of a single chain of triangles, (hence, without angle and side equations,) selecting the most *direct* series and the best-shaped triangles which can be found between it and the base. In complex cases, such as the transfer of the Epping base to the first primary line, Mt. Desert—Humpback, some trials become necessary, and the smallest value found for the probable error of the side may be adopted.

Let b equal the known base of a triangle, and a the side whose probable error is to be determined, the probable error of the base and of the adjacent angles A and C being given. The third angle is supposed not measured. We have—

$$da = \frac{\sin A}{\sin B} db - a \cot B dB + a \cot A dA$$

if we put the coefficients $l_1 = \frac{\sin A}{\sin B}$, $l_2 = -a \cot B \sin 1''$, $l_3 = +a \cot A \sin 1''$, and put in the place of the differentials the probable errors ε_1, ε_2, ε_3, for the base the angles B and A respectively, the latter quantities are expressed in seconds; and if $\varepsilon_a =$ probable error of side a, then

$$\varepsilon_a = \sqrt{[ll\varepsilon\varepsilon]}.$$

The coefficients l_1, l_2, l_3, may either be computed trigonometrically or logarithmically, as shown in the following example of the triangle formed by the Epping base and Burke. The probable errors ε_2, ε_3, we deduce from the average mean correction to a direction as resulting from the geometrical adjustment of the figure, viz:

	Mean correction to a direction.	Mean correction to an angle.	Probable error of an angle.
	$''$	$''$	$''$
For Epping base connection	±0.509	±0.720	±0.48
Between Mt. Desert and junction	0.230	0.326	0.22
Between Massachusetts base and junction	0.192	0.271	0.18
Between Fire Island base and junction	0.288	0.407	0.27

We have the following data, sufficient for our example:

$b = 8715.9$ metres ±0.016 metre
B=39° 20′ ±0″.48
A=51° 37′ ±0″.48 also, $a = 10781.2$ metres.

The following is the computation in full:

log sin A	9.8943	log a	4.0327	log a	4.0327
log sin B	9.8019	log cot B	0.0866	log cot A	9.8988
log l_1	0.0924	log sin 1″	4.6856	log sin 1″	4.6856
log l_1^2	0.1848	log l_2	8.8049_n	log l_3	8.6171
log ε_1^2	6.4082	log l_2^2	7.6098	log l_3^2	7.2342
log $l_1^2\varepsilon_1^2$	6.5930	log ε_2^2	9.3625	log ε_3^2	9.3625
	0.000392	log $l_2^2\varepsilon_2^2$	6.9723	log $l_3^2\varepsilon_3^2$	6.5967
			0.000938		0.000400

hence, $\varepsilon_a = \pm 0.0416$ metre.

By means of logarithmic differences the computation stands as follows:

log b	3.9403124+500db			
co-log sin B	0.1980886	−26dB		
log sin C	9.9999406		+0dC	
log sin A	9.8942678			+17dA
log a	4.0326688+500db—26dB+0dC+17dA			

$$a = 10781.2 + \tfrac{500}{406}db - \tfrac{26}{406}dB + \tfrac{17}{406}dA$$

and log l_1=log $\frac{500}{406}$=0.0904	log l_2=log $(-\frac{26}{406})$=8.806_n	log $\frac{17}{406}$=8.622
log ε_1= 8.204	log ε_2= 9.681	log ε_3= 9.681

whence $\varepsilon_a = \sqrt{[ll\varepsilon\varepsilon]} = \pm 0.0416$ metre, as above.

For the other side we have—

$$\log c = 4.1383416 + 500db - 26dB + 0dC$$
$$c = 13751.2 \quad + \tfrac{500}{316}db - \tfrac{26}{316}dB$$
and $\varepsilon_c = \pm 0.047$ metre.

The logarithmic process is preferable on account of its shortness. The above formula may also be written:

$$\varepsilon_a = a\varepsilon \sin 1'' \sqrt{\cot^2 A + \cot^2 B}$$

to which is yet to be added the probable error of the base, which is proportional to the ratio of the sides, and propagates itself through the triangulation independently of the errors of the angular measures, thus in the above example:

$\cot^2 A$	0.627	$\log a$	4.033
$\cot^2 B$	1.490	$\log b$	3.940
$\log a$	4.033	$\log \frac{a}{b}$	0.093
$\log \varepsilon$	9.681	$\log \varepsilon_1$	8.204
$\log \sin 1''$	4.686		8.297
	0.163		$\pm$0.0198
	8.563		
	$\pm$0.0366		

hence, $\varepsilon_a = \sqrt{(0.0366)^2 + (0.0198)^2} = \pm 0.0417$ metre, as before.

The formula given by Struve, in the Breitengradmessung*, gives an identical result. For a chain of triangles the numerical process may be shortened by employing the formula—

$$\varepsilon_a = a\varepsilon \sin 1'' \sqrt{\Sigma[\cot^2 A + \cot^2 B]} \quad - \; - \; - \; - \quad \text{(I)}$$

If the three angles are supposed measured, we have Laplace's formula, as given by Lieutenant Colonel James, in the Ordnance Survey†, slightly changed to conform to our notation:

$$\varepsilon_a = a\frac{\varepsilon}{\sqrt{3}} \sin 1'' \sqrt{\Sigma[\cot^2 A + \cot A \cot B + \cot^2 B]} \quad - \; - \; - \; - \quad \text{(II)}$$

As the angle B diminishes the probable error ε_a rapidly increases.

The formula (I) has been employed for the computation of the probable error of the junction as it resulted from each of the base lines. The probable error of the measure of each base has already been given, and the average probable error of each angle in the connecting branches of triangulation is contained in the preceding table, referred to in the example. To illustrate the process, the computation of the accuracy of the junction resulting from the middle branch of the triangulation is here appended:

Stations.	Angle.	Cot.
North base M—Beacon pole—South base M.	54° 07′	0.723
Beacon pole—South base M—North base M.	81 00	0.158
Beacon pole—Great Meadow—North base M.	58 49	0.605
Great Meadow—North base M—Beacon pole	70 10	0.361
Great Meadow—Blue—Beacon pole	36 10	1.368
Beacon pole—Great Meadow—Blue	69 10	0.381
Blue—Wachusett—Beacon pole	31 01	1.663
Wachusett—Beacon pole—Blue	82 05	0.139
Blue—Unkonoonuc—Wachusett	48 42	0.879
Wachusett—Blue—Unkonoonuc	39 41	1.205
Unkonoonuc—Monadnock—Wachusett	84 06	0.103
Monadnock—Wachusett—Unkonoonuc	47 31	0.916
Unkonoonuc—Gunstock—Monadnock	22 59	2.358
Monadnock—Unkonoonuc—Gunstock	124 06	—0.677

$\Sigma[\cot^2 A + \cot^2 B] = 14.940$ and by (I).

* Pages 413, 414, Vol. II. Dorpat, 1831.

$$\Delta a = \frac{mc \sin 1'' \cos A}{\sin C \cos \psi} \quad \text{where } \tan \psi = \frac{\tan A}{\tan C}$$

m = mean error of a measured angle A and C, and Δa = mean error of a concluded side a from the given side c.

† Ordnance Trigonometrical Survey of Great Britain and Ireland. By Lieutenant Colonel H. James. London, 1858.

Probable error of junction, ± 0.317 metre, due to the uncertainties in the angular measures. The probable error of the base line being ± 0.0358 metre, the proportional error in the junction becomes—

$$\pm 0.0358 \times \tfrac{94469}{17326} = \pm 0.195$$

hence the probable error of the junction $\sqrt{(0.317)^2 + (0.195)^2} = \pm 0.372$ metre.

Finally, we obtain the derived length of the junction, Monadnock—Gunstock, from each of the base lines, as follows:

	m.	m.	(log.)
From the Epping base	94469.2155	±0.78	±0.0000035 857
From the Massachusetts base	94468.3841	±0.37	17 010
From the Fire Island base	94468.7565	±0.77	35 398
Weighted mean	94468.5716	±0.15	0.0000006 896

It will be useful to know how much of the above probable error is due to that of a base measure, and how much to intervening triangulation. We have—

	Probable error in junction line.		
	Due to base measure.	Due to triangulation.	Both combined.
	m.	m.	m.
From Epping base	±0.17	±0.76	±0.78
From Massachusetts base	0.20	0.32	0.37
From Fire Island base	0.39	0.66	0.77

It is gratifying to observe that the deduced lengths of the junction from each of the base lines shows an agreement *within* the probable error assigned. It also proves that the assumptions made in computing the probable errors lead to satisfactory results.

The above probable error (± 0.15) in the weighted mean of the junction amounts to $\frac{1}{630000}$ nearly of its length, and on the average, for the whole triangulation, the probable error of any assigned length of side is nearly its $\frac{1}{288000}$ part. This last fraction amounts to ± 0.22 inch in a statute mile, or a little less than two feet in one hundred miles.

The following values, by which the accuracy of the triangulation may be judged of, are appended:

Part.	No. of triangles	Greatest residual in angles of any triangle.	No. of + errors.	No. of — errors	Probable error of a direction, derived from △ residuals.	Angles measured apparently too great.	Instruments used.
		″			″	″	
I	46	2.626	18	28	±0.299	—0.120	30-inch and repeating theodolites.
II	28	1.989	18	10	0.235	+0.049	30-inch theodolite.
III	24	1.537	14	10	0.227	+0.061	30-inch and repeating theodolites.
IV	30	1.586	18	12	0.219	+0.052	30-inch theodolite.

There is no bias in the distribution of + and — residuals with respect to the size of the triangles. If we deduct the probable observing error of a direction, or that error due to the discrepancies of the individual measures at *each station*, from the probable error of a direction resulting from the closing of the triangles, we find the pure triangle combination error $\epsilon_{\triangle}$ of a direction, as follows:

In part I	±0″.173
In part II	0″.194
In part III	0″.174
In part IV	0″.150

The weights assigned in the adjustment depend upon these numbers *combined* with that resulting from the observations directly.

Finally, the corrections to the observed directions, actually required by the adjustment of the geometrical figure, have the following values:

	Greatest correction to any direction.	Average correction to any one direction.
	"	"
Part I	1.24	±0.509
Part II	0.81	0.230
Part III	0.47	0.192
Part IV	1.25	0.288

The average length of the triangle sides, including the base lines, but excluding the Epping base connection, is 38.6 statute miles; the longest side, 84.1 statute miles; and the sum total of lengths, 3,280 statute miles.

The distance equations between the junction and each base line were next combined with the equations of the preceding adjustments, making use of Gauss's theorem, which proves the following: If adjusted observations, among which one or more conditions were at first omitted, be readjusted as if they were observed quantities and using now all equations of condition, we will find the same results we would have obtained if at first all conditions had been introduced.

To obviate the inconvenience of finding slightly different values for the angle (and side) corrections in the central portion of the triangulation forming part of each of the three branches, the middle branch was first treated and the upper and lower branches terminated between their respective base lines and the sides Gunstock—Agamenticus and Monadnock—Wachusett.

In the following table of resulting angles and sides the first column contains the reference number of the triangle; the second, the names of the stations forming the same; the third, the observed angles; the fourth, their corrections due to adjustment; the fifth, the spherical angles thus corrected; the sixth, the spherical excess of the triangle; the seventh, the logarithms of the distances, (in metres;) the eighth, the distances in metres; and the ninth, the distances in miles. It will be readily understood that each distance refers to the side which in the given triangle is opposite to the angle named on the same line with it.

Resulting angles and distances of the primary triangulation between the Epping, Massachusetts, and Fire Island base lines.

No. of △	Name of stations.	Observed angles.	Corrections by adjustment.	Resulting angles, seconds.	Spherical excess.	Log. distances.	Distances, metres.	Distances, statute miles.
		° ′ ″	″	″	″			
	Burke	39 19 35.850	+ .080	35.930	....	3.94031434	8715.942	5.42
1	West Base	89 03 11.750	— .422	11.328	.238	4.13834364	13751.296	8.54
	East Base	51 37 12.900	+ .080	12.980	....	4.03267078	10781.291	6.70
	Tunk	16 04 34.010	+ .906	34.916	....	3.94031434	8715.942	5.42
2	West Base	138 04 57.080	— .122	56.958	.203	4.32277880	21027.072	13.07
	East Base	25 50 29.840	— 1.511	28.329	....	4.13732824	13719.183	8.52
	Tunk	50 45 11.850	— .039	11.811	....	4.03267078	10781.291	6.70
3	West Base	49 01 45.330	+ .300	45.630	.283	4.02166233	10511.443	6.53
	Burke	80 13 02.640	+ .203	02.843	....	4.13732824	13719.183	8.52
	Tunk	34 40 37.840	— .945	36.895	....	4.13834364	13751.296	8.54
4	East Base	25 46 43.060	+ 1.591	44.651	.319	4.02166233	10511.443	6.53
	Burke	119 32 38.490	+ .283	38.773	....	4.32277880	21027.072	13.07
	Pigeon	19 00 56.560	— 1.180	55.380	....	3.94031434	8715.942	5.42
5	West Base	64 55 08.300	+ .951	09.251	.533	4.38432457	24228.391	15.05
	East Base	96 03 55.500	+ .402	55.902	....	4.42489692	26600.936	16.53
	Pigeon	33 44 59.030	— .174	58.856	....	4.13834364	13751.296	8.54
6	Burke	101 48 19.820	— 1.005	18.815	.592	4.38432456	24228.390	15.05
	East Base	44 26 42.600	+ .322	42.922	....	4.23884761	17331.957	10.77
	Pigeon	49 08 34.310	+ .629	34.939	....	4.32277880	21027.072	13.07
7	Tunk	.60 37 58.620	+ .084	58.704	1.216	4.38432457	24228.391	15.05
	East Base	70 13 25.660	+ 1.913	27.573	....	4.41766018	26161.352	16.26
	Pigeon	14 44 02.470	+ 1.006	03.476	....	4.03267078	10781.291	6.70
8	Burke	141 07 55.670	— .925	54.745	.298	4.42489691	26600.936	16.53
	West Base	24 08 03.450	— 1.373	02.077	....	4.23884761	17331.957	10.77
	Pigeon	30 07 37.750	+ 1.809	39.559	....	4.13732824	13719.183	8.52
9	Tunk	76 42 32.630	+ .990	33.620	.886	4.42489691	26600.936	16.53
	West Base	73 09 48.780	— 1.073	47.707	....	4.41766018	26161.352	16.26
	Pigeon	15 23 35.280	+ .803	36.083	....	4.02166233	10511.443	6.53
10	Tunk	25 57 20.780	+ 1.029	21.809	.305	4.23884761	17331.957	10.77
	Burke	138 39 01.690	+ .723	02.413	....	4.41766018	26161.352	16.26
	Humpback	9 55 37.650	— .051	37.599	....	3.94031434	8715.942	5.42
11	East Base	27 41 01.010	+ .320	01.330	.317	4.37086002	23488.756	14.59
	West Base	142 23 21.940	— .551	21.389	....	4.48932942	30855.275	19.17
	Humpback	25 31 14.879	— .220	14.659	....	4.13834364	13751.296	8.54
12	East Base	79 18 13.910	+ .400	14.310	1.057	4.49641939	31363.129	19.49
	Burke	75 10 31.480	+ .609	32.089	....	4.48932943	30855.276	19.17
	Humpback	42 39 01.097	— .042	01.055	....	4.32277880	21027.072	13.07
13	East Base	53 31 30.850	— 1.192	29.658	1.323	4.39717417	24955.954	15.51
	Tunk	83 49 30.540	+ .070	30.610	....	4.48932943	30855.276	19.17
	Humpback	24 26 46.698	— .358	46.340	....	4.38432457	24228.391	15.05
14	East Base	123 44 56.510	+ .721	57.231	1.576	4.68734690	48679.589	30.25
	Pigeon	31 48 17.670	+ .335	18.005	....	4.48932942	30855.275	19.17
	Humpback	15 35 37.229	— .169	37.060	....	4.03267078	10781.291	6.70
15	West Base	128 33 26.310	+ .973	27.283	.502	4.49641939	31363.129	19.49
	Burke	35 50 55.630	+ .529	56.159	....	4.37086002	23488.757	14.59
	Humpback	32 43 23.447	+ .009	23.456	....	4.13732824	13719.183	8.52
16	West Base	79 31 40.980	+ .674	41.654	.804	4.39717417	24955.954	15.51
	Tunk	67 44 56.530	— .836	55.694	....	4.37086003	23488.757	14.59
	Humpback	14 31 09.048	— .308	08.740	....	4.42489691	26600.936	16.53
17	West Base	152 41 29.760	— .399	29.361	.725	4.68734691	48679.590	30 25
	Pigeon	12 47 21.110	+ 1.515	22.625	....	4.37086004	23488.757	14.59
	Humpback	17 07 46.218	+ .178	46.396	....	4.02166233	10511.443	6.53
18	Burke	44 22 07.010	— .326	06.684	.585	4.39717418	24955.954	15.51
	Tunk	118 30 08.380	— .875	07.505	....	4.49641940	31363.130	19.49

Resulting angles and distances of the primary triangulation, &c.—Continued.

No. of △	Name of stations.	Observed angles.	Corrections by adjustment.	Resulting angles, seconds.	Spherical excess.	Log. distances.	Distances, metres.	Distances, statute miles.
		° ′ ″	″	″	″			
	Humpback	1 04 28.181	+ .1384	28.3194		4.23884761	17331.957	10.77
19	Pigeon	1 56 41.360	— .5092	40.8508	.0726	4.49641939	31363.129	19.49
	Burke	176 58 51.300	— .3976	50.9024		4.68734690	48679.590	30.25
	Humpback	18 12 14.399	+ .316	14.715		4.41766018	22161.352	16.26
20	Pigeon	17 20 16.640	+ .293	16.933	.962	4.39717418	24955.954	15.51
	Tunk	144 27 29.160	+ .154	29.314		4.68734691	48679.590	30.25
	Mt. Desert	5 26 36.898	+ .337	37.235		4.13834364	13751.296	8.54
21	Burke	160 58 42.360	— 1.051	41.309	.387	4.67435400	47244.798	29.36
	East Base	13 34 42.400	— .557	41.843		4.53187892	34031.330	21.15
	Mt. Desert	23 17 01.756	— .268	01.488		4.32277880	21027.072	13.07
22	Tunk	117 21 33.910	— .294	33.616	1.598	4.67435400	47244.798	29.36
	East Base	39 21 25.460	+ 1.034	26.494		4.52806536	33733.807	20.96
	Mt. Desert	25 10 22.487	+ .451	22.938		4.38432456	24228.391	15.05
23	East Base	30 52 00.200	+ .878	01.078	1.489	4.46573175	29223.468	18.16
	Pigeon	123 57 37.170	+ .303	37.473		4.67435400	47244.798	29.36
	Mt. Desert	32 16 26.482	— .062	26.420		4.48932943	30855.276	19.17
24	Humpback	54 50 40.476	+ .643	41.119	3.692	4.67435400	47244.798	29.36
	East Base	92 52 56.310	— .157	56.153		4.76126803	57712.253	35.86
	Mt. Desert	17 50 24.858	— .605	24.253		4.02166233	10511.443	6.53
25	Tunk	82 40 56.070	+ .651	56.721	.892	4.53187893	34031.331	21.15
	Burke	79 28 39.150	+ .768	39.918		4.52806536	33733.807	20.96
	Mt. Desert	30 36 59.385	+ .788	60.173		4.23884761	17331.957	10.77
26	Burke	59 10 22.540	— .045	22.495	1.284	4.46573175	29223.468	18.16
	Pigeon	90 12 38.140	+ .476	38.616		4.53187892	34031.330	21.15
	Mt. Desert	26 49 49.584	— .399	49.185		4.49641939	31363.129	19.49
27	Humpback	29 19 25.597	+ .864	26.461	2.248	4.53187892	34031.330	21.15
	Burke	123 50 46.160	+ .442	46.602		4.76126803	57712.253	35.86
	Mt. Desert	48 27 24.243	+ .183	24.426		4.41766018	26161.352	16.26
28	Tunk	56 43 35.290	— .378	34.912	1.871	4.46573176	29223.468	18.16
	Pigeon	74 49 02.860	— .327	02.533		4.52806536	33733.807	20.96
	Mt. Desert	8 59 24.726	+ .206	24.932		4.39717417	24955.954	15.51
29	Humpback	12 11 39.379	+ .686	40.065	.772	4.52806536	33733.807	20.96
	Tunk	158 48 55.550	+ .225	55.775		4.76126803	57712.253	35.86
	Mt. Desert	57 26 48.969	+ .389	49.358		4.68734691	48679.590	30.25
30	Humpback	30 23 53.778	+ 1.002	54.780	3.605	4.46573176	29223.468	18.16
	Pigeon	92 09 19.500	— .033	19.467		4.76126803	57712.253	35.86
	Howard	11 28 06.015	+ 1.171	07.186		4.13834364	13751.296	8.54
31	Burke	30 19 45.160	— 1.500	43.660	.812	4.54311755	34923.483	21.70
	East Base	138 12 09.940	+ .026	09.966		4.66365876	46095.524	28.64
	Howard	33 30 40.141	+ .204	40.345		4.38432456	24228.390	15.05
32	Pigeon	52 43 54.520	+ .233	54.753	2.141	4.54311754	34923.482	21.70
	East Base	93 45 27.340	— .297	27.043		4.64137453	43789.958	27.21
	Howard	17 33 01.364	+ 1.028	02.392		4.48932943	30855.276	19.17
33	East Base	142 29 36.150	— .424	35.726	1.664	4.79449045	62300.345	38.71
	Humpback	19 57 24.016	— .470	23.546		4.54311753	34923.482	21.70
	Howard	32 11 14.197	+ .316	14.513		4.67435400	47244.798	29.36
34	Mt. Desert	23 11 19.990	+ .818	20.808	3.443	4.54311754	34923.482	21.70
	East Base	124 37 27.540	+ .582	28.122		4.86322898	72984.222	45.35
	Howard	22 02 34.126	— .968	33.158		4.23884761	17331.957	10.77
35	Pigeon	86 28 53.550	+ .059	53.609	1.921	4.66365875	46095.523	28.64
	Burke	71 28 34.660	+ .494	35.154		4.64137453	43789.958	27.21
	Howard	29 01 07.379	+ 2.199	09.578		4.49641939	31363.129	19.49
36	Burke	105 30 16.640	— .891	15.749	3.532	4.79449045	62300.346	38.71
	Humpback	45 28 38.895	— .690	38.205		4.66365876	46095.524	28.64

Resulting angles and distances of the primary triangulation, &c.—Continued.

No. of Δ	Name of stations.	Observed angles.	Corrections by adjustment.	Resulting angles, seconds.	Spherical excess.	Log. distances.	Distances, metres.	Distances, statute miles.
		° ′ ″	″	″	″			
	Howard	20 43 08.182	— .856	07.326		4.53187892	34031.330	21.15
37	Mt. Desert	28 37 56.888	+ 1.155	58.043	3.018	4.66365876	46095.524	28.64
	Burke	130 38 57.200	+ .449	57.649		4.86322898	72984.222	45.35
	Howard	51 03 41.505	+ 1.231	42.736		4.68734691	48679.590	30.25
38	Pigeon	84 32 12.190	+ .569	12.759	5.381	4.79449046	62300.346	38.71
	Humpback	44 24 10.714	— .828	09.886		4.64137453	43789.958	27.21
	Howard	1 19 25.944	— .1117	25.8323		4.46573176	29223.468	18.16
39	Pigeon	176 41 31.690	+ .5345	32.2245	.1873	4.86322898	72984.222	45.35
	Mt. Desert	1 59 02.497	— .3665	02.1305		4.64137453	43789.958	27.21
	Howard	49 44 15.561	+ 1.344	16.905		4.76126803	57712.253	35.86
40	Mt. Desert	55 27 46.472	+ .756	47.228	8.799	4.79449045	62300.345	38.71
	Humpback	74 48 04.492	+ .174	04.666		4.86322898	72984.222	45.35
	Cooper	32 00 62.260	— 1.165	61.095		4.49641939	31363.129	19.49
41	Burke	62 44 36.700	+ 1.178	37.878	4.168	4.72089320	52588.793	32.68
	Humpback	85 14 25.280	— .085	25.195		4.77050808	58953.295	36.63
	Cooper	2 24 39.965	— .0629	39.9021		4.53187892	34031.330	21.15
42	Mt. Desert	4 10 44.694	+ .4672	45.1612	.5839	4.77050808	58953.295	36.63
	Burke	173 24 37.140	— 1.6194	35.5206		4.96774424	92841.949	57.69
	Cooper	51 15 31.369	+ .578	31.947		4.66365876	46095.524	28.64
43	Howard	85 58 53.870	+ .990	54.860	4.678	4.77050808	58953.295	36.63
	Burke	42 45 39.940	— 2.069	37.871		4.60340214	40123.808	24.93
	Cooper	34 25 42.225	— 1.228	40.997		4.76126803	57712.253	35.86
44	Mt. Desert	31 00 34.278	+ .069	34.347	7.000	4.72089321	52588.794	32.68
	Humpback	114 33 50.877	+ .779	51.656		4.96774425	92841.949	57.69
	Cooper	83 16 33.629	— .587	33.042		4.79449045	62300.346	38.71
45	Howard	56 57 46.491	— 1.209	45.282	5.314	4.72089320	52588.794	32.68
	Humpback	39 45 46.385	+ .605	46.990		4.60340214	40123.808	24.93
	Cooper	48 50 51.404	+ .641	52.045		4.86322898	72984.222	45.35
46	Howard	106 41 62.052	+ .134	62.186	7.113	4.96774425	92841.949	57.69
	Mt. Desert	24 27 12.194	+ .688	12.882		4.60340214	40123.808	24.93
	Ragged	29 24 62.122	— .086	62.036		4.76126803	57712.253	35.86
47	Humpback	39 54 29.668	+ .022	29.690	10.322	4.87728145	75384.394	46.84
	Mt. Desert	110 40 38.820	— .224	38.596		5.04113807	109935.529	68.31
	Harris	40 32 25.257	— .168	25.089		4.76126803	57712.253	35.86
48	Humpback	66 02 39.111	— .670	38.441	11.382	4.90925052	81142.899	50.42
	Mt. Desert	73 25 08.221	— .369	07.852		4.92992743	85099.583	52.88
	Harris	65 08 37.247	+ .106	37.353		4.87728145	75384.394	46.84
49	Mt. Desert	37 15 30.599	+ .145	30.744	9.392	4.70154531	50297.374	31.25
	Ragged	77 35 61.156	+ .139	61.295		4.90925052	81142.899	50.42
	Harris	105 40 62.504	— .063	62.441		5.04113807	109935.529	68.31
50	Humpback	26 08 09.443	— .692	08.751	10.451	4.70154531	50297.374	31.25
	Ragged	48 10 59.034	+ .225	59.259		4.92992743	85099.583	52.88
	Mt. Blue	26 55 40.812	+ .365	41.177		4.70154531	50297.374	31.25
51	Harris	94 22 34.433	— .159	34.274	12.070	5.04431906	110743.708	68.81
	Ragged	58 41 56.897	— .278	56.619		4.97726809	94900.410	58.97
	Sebattis	32 08 13.235	+ .008	13.243		4.70154531	50297.374	31.25
52	Harris	52 02 19.013	— .053	18.960	9.460	4.87244398	74549.370	46.32
	Ragged	95 49 37.149	+ .108	37.257		4.97343942	94067.461	58.45
	Sebattis	69 29 07.402	+ .377	07.779		4.97726809	94900.410	58.97
53	Mt. Blue	68 10 51.744	+ .410	52.154	15.247	4.97343942	94067.461	58.45
	Harris	42 20 15.420	— .106	15.314		4.83404989	68241.708	42.40
	Sebattis	101 37 20.637	+ .385	21.022		5.04431906	110743.708	68.81
54	Mt. Blue	41 15 10.932	+ .045	10.977	12.637	4.87244398	74549.370	46.32
	Ragged	37 07 40.252	+ .386	40.638		4.83404989	68241.708	42.40

Resulting angles and distances of the primary triangulation, &c.—Continued.

No. of Δ	Name of stations.	Observed angles.	Corrections by adjustment.	Resulting angles, seconds.	Spherical excess.	Log. distances.	Distances, metres.	Distances, statute miles.
		° ′ ″	″	″	″			
	Pleasant	54 39 35.737	— .050	35.687		5.04431906	110743.708	68.81
55	Mt. Blue	85 35 26.004	— .221	25.783	24.311	5.13149435	135361.248	84.11
	Ragged	39 45 23.108	— .267	22.841		4.93861951	86819.946	53.95
	Pleasant	51 26 46.938	+ .253	47.191		4.83404989	68241.708	42.40
56	Mt. Blue	44 20 15.072	— .267	14.805	10.501	4.78523148	60986.187	37.89
	Sebattis	84 13 08.601	— .096	08.505		4.93861951	86819.946	53.95
	Pleasant	3 12 48.799	— .3022	48.4968		4.87244398	74549.370	46.32
57	Sebattis	174 09 30.762	— .2893	30.4727	1.1740	5.13149435	135361.248	84.11
	Ragged	2 37 42.856	— .6515	42.2045		4.78523148	60986.187	37.89
	Independence	77 48 18.280	— .206	18.074		4.78523148	60986.187	37.87
58	Pleasant	48 45 61.107	— .490	60.617	5.829	4.67137837	46922.200	29.15
	Sebattis	53 25 47.241	— .103	47.138		4.69992597	50110.181	31.14
	Independence	25 16 42.166	— .289	41.877		4.83404989	68241.708	42.40
59	Mt. Blue	17 04 28.298	— .347	27.951	5.471	4.67137837	46922.200	29.15
	Sebattis	137 38 55.842	— .199	55.643		5.03206803	107663.385	66.90
	Independence	52 31 36.114	+ .083	36.197		4.93861951	86819.946	53.95
60	Pleasant	100 12 48.045	— .237	47.808	10.859	5.03206803	107663.385	66.90
	Mt. Blue	27 15 46.774	+ .080	46.854		4.69992596	50110.180	31.14
	Gunstock	34 19 40.221	+ 1.012	41.233		4.69992596	50110.180	31.14
61	Pleasant	91 54 04.337	+ .300	04.637	9.106	4.94847008	88811.679	55.18
	Independence	53 46 22.590	+ .646	23.236		4.85540733	71681.540	44.54
	Agamenticus	85 39 41.257	— .118	41.139		4.94847008	88811.679	55.18
62	Gunstock	48 29 43.830	— .844	42.986	10.781	4.82413469	66701.360	41.44
	Independence	45 50 46.858	— .202	46.656		4.80551556	63902.163	39.71
	Agamenticus	33 20 57.310	+ .334	57.644		4.69992596	50110.180	31.14
63	Pleasant	47 01 59.612	+ 1.211	60.823	8.359	4.82413469	66701.360	41.44
	Independence	99 37 09.448	+ .444	09.892		4.95362685	89872.506	55.84
	Agamenticus	52 18 43.947	— .452	43.495		4.85540733	71681.540	44.54
64	Gunstock	82 49 24.051	+ .168	24.219	11.529	4.95362685	89872.506	55.84
	Pleasant	44 51 64.725	— .910	63.815		4.80551556	63902.163	39.71
	Beacon pole	54 06 45.246	— .144	45.102		4.23870774	17326.376	10.77
65	North Base	44 52 58.639	— .112	58.527	.655	4.17872731	15091.323	9.38
	South Base	81 00 16.660	+ .366	17.026		4.32475753	21123.094	13.12
	Great Meadow	58 49 15.000	— .485	14.515		4.32475753	21123.094	13.12
66	Beacon pole	51 01 17.428	— .282	17.146	.968	4.28314540	19193.112	11.93
	North Base	70 09 29.812	— .505	29.307		4.36593185	23223.723	14.43
	Blue Hill	36 10 06.828	— .485	06.343		4.36593185	23223.723	14.43
67	Great Meadow	69 09 39.729	— .113	39.616	2.090	4.56558109	36777.406	22.85
	Beacon pole	74 40 16.674	— .543	16.131		4.57923120	37951.697	23.58
	Copecut	10 02 58.269	+ .5678	58.8368		4.36593185	23223.723	14.43
68	Beacon pole	9 27 01.406	+ .2521	01.6581	.4300	4.33949075	21851.978	13.58
	Great Meadow	160 29 59.351	+ .5841	59.9351		4.64762973	44425.235	27.60
	Copecut	41 58 51.444	+ .005	51.449		4.56558109	36777.406	22.85
69	Beacon pole	84 07 18.080	— .292	17.788	4.124	4.73794371	54694.507	33.98
	Blue Hill	53 53 55.439	— .552	54.887		4.64762973	44425.235	27.60
	Copecut	31 55 53.175	— .563	52.612		4.57923120	37951.697	23.58
70	Great Meadow	130 20 20.920	— .471	20.449	1.604	4.73794371	54694.507	33.98
	Blue Hill	17 43 48.611	— .068	48.543		4.33949075	21851.978	13.58
	Manomet	29 59 42.889	— .189	42.700		4.56558109	36777.406	22.85
71	Beacon pole	46 49 04.901	— .689	04.212	4.874	4.72951266	53642.951	33.33
	Blue Hill	103 11 18.606	— .644	17.962		4.85507282	71626.350	44.50
	Manomet	66 34 04.686	— .134	04.552		4.73794371	54694.507	33.98
72	Copecut	64 08 37.851	+ .166	38.017	5.644	4.72951266	53642.951	33.33
	Blue Hill	49 17 23.167	— .092	23.075		4.65499999	45185.593	28.08

Resulting angles and distances of the primary triangulation, &c.—Continued.

No. of △	Name of stations.	Observed angles.	Corrections by adjustment.	Resulting angles, seconds.	Spherical excess.	Log. distances.	Distances, metres.	Distances, statute miles.
		° ′ ″	″	″	″			
	Manomet	36 34 21.797	+ .055	21.852	....	4.64762973	44425.235	27.60
73	Copecut	106 07 29.295	+ .170	29.465	4,894	4.85507281	71626.348	44.50
	Beacon pole	37 18 13.179	+ .398	13.577	....	4.65499998	45185.592	28.08
	Thompson	44 15 19.752	+ .048	19.800	....	4.72951266	53642.951	33.33
74	Manomet	45 08 44.847	— .010	44.837	7.416	4.73633225	54491.938	33.86
	Blue Hill	90 36 02.575	+ .204	02.779	....	4.88572636	76864.598	47.76
	Wachusett	31 00 49.404	+ .195	49.599	....	4.56558109	36777.406	22.85
75	Blue Hill	66 54 01.776	+ .710	02.486	6.068	4.81727905	65656.700	40.80
	Beacon pole	82 05 13.351	+ .632	13.983	....	4 84941966	70700.040	43.93
	Wachusett	34 04 13.921	+ .071	13.992	....	4.73633225	54491.938	33.86
76	Thompson	46 37 19.030	— .149	18.881	9.646	4.84941966	70700.040	43.93
	Blue Hill	99 18 37.043	— .270	36.773	....	4.98223089	95991.083	59.64
	Unkonoonuc	48 41 42.279	+ .542	42.821	....	4.84941966	70700.040	43.93
77	Blue Hill	39 40 53.165	— .002	53.163	10.776	4.77882978	60093.816	37.34
	Wachusett	91 37 34.719	+ .073	34.792	....	4.97349067	94078.562	58.46
	Unkonoonuc	83 56 40.320	+ .165	40.485	....	4.98223089	95991.083	59.64
78	Thompson	38 30 10.975	+ .090	11.065	12.350	4.77882978	60093.816	37.34
	Wachusett	57 33 20.798	+ .002	20.800	....	4.91095456	81461.905	50.62
	Unkonoonuc	35 14 58.041	— .376	57.665	....	4.73633225	54491.938	33.86
79	Thompson	85 07 30.005	— .059	29.946	11.221	4.97349067	94078.562	58.46
	Blue Hill	59 37 43.878	— .268	43.610	....	4.91095456	81461.905	50.62
	Agamenticus	67 35 59.823	— .731	59.092	....	4.91095456	81461.905	50.62
80	Thompson	61 50 53.264	— .212	53.052	12.398	4.89034638	77686.647	48.27
	Unkonoonuc	50 33 20.339	— .085	20.254	....	4.83277652	68041.914	42.28
	Gunstock	44 18 57.361	+ .210	57.571	....	4.91095456	81461.905	50.62
81	Thompson	32 06 61.186	— .295	60.891	12.454	4.79233638	61992.105	38.52
	Unkonoonuc	103 34 13.952	+ .040	13.992	....	5.05443048	113352.338	70.43
	Gunstock	76 11 25.038	+ .006	25.044	....	4.89034638	77686.647	48.27
82	Agamenticus	50 47 50.512	+ .464	50.976	9.759	4.79233638	61992.105	38.52
	Unkonoonuc	53 00 53.613	+ .126	53.739	....	4.80551556	63902.163	39.71
	Gunstock	31 52 27.677	— .203	27.474	....	4.83277652	68041.914	42.28
83	Agamenticus	118 23 50.335	— .265	50.070	9.703	5.05443049	113352.340	70.43
	Thompson	29 43 52.078	+ .081	52.159	....	4.80551557	63902.165	39.71
	Gunstock	48 00 55.063	— .274	54.789	....	4.98223089	95991.083	59.64
84	Thompson	70 37 12.161	— .203	11.958	26.040	5.08573116	121823.525	75.69
	Wachusett	61 22 19.463	— .170	19.293	....	5.05443048	113352.338	70.43
	Gunstock	3 41 57.702	— .4826	57.2194	....	4.77882978	60093.816	37.34
85	Unkonoonuc	172 29 05.728	— .2054	05.5226	1.2360	5.08573116	121823.525	75.69
	Wachusett	3 48 58.665	— .1710	58.4940	....	4.79233637	61992.103	38.52
	Monadnock	84 06 26.970	— .085	26.884	....	4.77882978	60093.816	37.34
86	Unkonoonuc	48 22 59.000	— .330	58.671	5.077	4.65479746	45164.526	28.06
	Wachusett	47 30 39.700	— .178	39.522	....	4.64883481	44548.677	27.68
	Monadnock	117 01 19.427	+ .002	19.429	....	5.08573116	121823.525	75.69
87	Gunstock	19 17 08.672	+ .513	09.185	9.642	4.65479747	45164.527	28.06
	Wachusett	43 41 41.035	— .007	41.028	....	4.97528733	94468.568	58.70
	Monadnock	32 54 52.457	+ .091	52.548	....	4.79233638	61992.105	38.52
88	Gunstock	22 59 06.374	+ .028	06.402	5.801	4.64883482	44548.678	27.68
	Unkonoonuc	124 06 06.728	+ .123	06.851	....	4.97528734	94468.570	58.70
	Ruland	27 17 02.716	— .230	02.486	....	4.14795353	14058.971	8.74
89	East Base	112 32 52.425	— .053	52.372	.652	4.45217317	28325.212	17.60
	West Base	40 10 05.353	+ .441	05.794	....	4.29629067	19782.933	12.29
	West Hills	21 21 45.133	+ .879	46.012	....	4.14795353	14058.971	8.74
90	East Base	44 48 25.076	— 1.418	23.658	.888	4.43454271	27198.360	16.90
	West Base	113 49 51.571	— .353	51.218	....	4.54782832	35304.358	21.94

Resulting angles and distances of the primary triangulation, &c.—Continued.

No. of △	Name of stations.	Observed angles.	Corrections by adjustment.	Resulting angles, seconds.	Spherical excess.	Log. distances.	Distances, metres.	Distances, statute miles.
		° ′ ″	″	″	″			
	West Hills	54 43 16.067	+ .180	16.247		4.45217317	28325.212	17.60
91	Ruland	51 36 59.619	+ .585	60.204	1.877	4.43454271	27198.360	16.90
	West Base	73 39 46.218	− .792	45.426		4.52239689	33296.370	20.69
	West Hills	33 21 30.934	− .697	30.237		4.29629067	19782.933	12.29
92	Ruland	78 54 02.335	+ .355	02.690	1.641	4.54782833	35304.359	21.94
	East Base	67 44 27.349	+ 1.365	28.714		4.52239689	33296.370	20.69
	Tashua	38 20 42.545	− .071	42.474		4.52239689	33296.370	20.69
93	Ruland	73 59 43.309	− .454	42.855	4.033	4.71256125	51589.492	32.05
	West Hills	67 39 38.265	+ .439	38.704		4.69584767	49641.817	30.84
	Wooster	29 18 52.587	− .202	52.385		4.52239689	33296.370	20.69
94	Ruland	61 26 28.056	− .291	27.765	5.048	4.77621197	59732.676	37.11
	West Hills	89 14 44.741	+ .157	44.898		4.83252064	68001.836	42.25
	Wooster	28 53 58.286	− .2045	58.0815		4.69584767	49641.817	30.84
95	Tashua	138 32 49.096	− .4045	48.6915	1.8623	4.83252064	68001.836	42.25
	Ruland	12 33 15.253	− .1637	15.0893		4.34883597	22327.288	13.87
	Wooster	58 12 50.873	− .407	50.466		4.71256125	51589.492	32.05
96	Tashua	100 12 06.551	− .334	06.217	2.877	4.77621197	59732.676	37.11
	West Hills	21 35 06.476	− .282	06.194		4.34883597	22327.288	13.87
	Sandford	23 24 41 555	+ .701	42.256		4.52239689	33296.370	20.69
97	Ruland	101 19 14.964	− .079	14.885	5.707	4.91471599	82170.511	51.06
	West Hills	55 16 08.210	+ .356	08.566		4.83803092	68870.133	42.79
	Sandford	19 12 16.858	− .7628	16.0952		4.71256125	51589.492	32.05
98	West Hills	12 23 30.055	+ .0837	30.1387	2.3088	4.52705883	33655.716	20.91
	Tashua	148 24 16.218	− .1431	16.0749		4.91471599	82170.511	51.06
	Sandford	42 36 58.413	− .062	58.351		4.69584767	49641.817	30.84
99	Ruland	27 19 31.655	+ .376	32.031	3.983	4.52705883	33655.716	20.91
	Tashua	110 03 33.673	− .072	33.601		4.83803092	68870.133	42.79
	Sandford	45 38 51.558	− .147	51.411		4.77621197	59732.676	37.11
100	West Hills	33 58 36.531	− .200	36.331	6.961	4.66917110	46684.327	29.01
	Wooster	100 22 39.317	− .098	39.219		4.91471599	82170.511	51.06
	Sandford	69 03 33.113	+ .553	33.666		4.83252064	68001.836	42.25
101	Ruland	39 52 46.908	+ .212	47.120	7.620	4.66917110	46684.327	29.01
	Wooster	71 03 46.730	+ .104	46.834		4.83803092	68870.133	42.79
	Sandford	26 26 34.700	+ .615	35.315		4.34883597	22327.288	13.87
102	Tashua	111 23 37.231	+ .477	37.708	1.776	4.66917110	46684.327	29.01
	Wooster	42 09 48.444	+ .309	48.753		4.52705883	33655.716	20.91
	Ivy	47 40 51.621	+ .402	52.023		4.66917110	46684.327	29.01
103	Sandford	78 31 14.533	− .015	14.518	5.915	4.79151375	61874.792	38.45
	Wooster	53 47 59.208	+ .166	59.374		4.70713817	50949.294	31.66
	Box	49 35 39.881	− .179	39.702		4.70713817	50949.294	31.66
104	Sandford	74 02 34.416	− .244	34.172	6.925	4.80842013	64330.974	39.97
	Ivy	56 21 53.037	+ .014	53.051		4.74590992	55707.019	34.61
	Mt. Tom	34 16 43.537	− .150	43.387		4.74590992	55707.019	34.61
105	Box	114 15 55.751	+ .217	55.968	6.652	4.95506986	90171.617	56.03
	Sandford	31 27 27.481	− .184	27.297		4.71279171	51616.875	32.07
	Bald Hill	34 47 46.780	+ .110	46.890		4.80842013	64330.974	39.97
106	Box	130 24 14.206	− .191	14.015	3.579	4.93371404	85844.809	53.34
	Ivy	14 48 02.805	− .131	02.674		4.45935575	28797.564	17.89
	Bald Hill	80 50 44.995	− .242	44.753		4.71279171	51616.875	32.07
107	Box	65 43 58.336	− .586	57.750	3.438	4.67818030	47662.882	29.62
	Mt. Tom	33 25 21.068	− .133	20.935		4.45935575	28797.564	17.89
	Wachusett	42 19 11.847	− 1.244	10.603		4.67818030	47662.882	29.62
108	Bald Hill	75 16 43.565	+ .109	43.674	7.338	4 83550267	68470.369	42.54
	Mt. Tom	62 24 13.289	− .228	13.061		4.79754469	62740.025	38.98

Resulting angles and distances of the primary triangulation, &c.—Continued.

No. of △	Name of stations.	Observed angles.	Corrections by adjustment.	Resulting angles, seconds.	Spherical excess.	Log. distances.	Distances, metres.	Distances, statute miles.
		° ′ ″	″	″	″			
	Monadnock	28 39 22.247	— .415	21.832	....	4.67818030	47662.882	29.62
109	Bald Hill	55 27 54.745	— .544	54.201	9.850	4.91316518	81877.614	50.87
	Mt. Tom	95 52 53.979	— .162	53.817	....	4.99506682	98870.520	61.43
	Monadnock	56 44 47.544	+ .067	47.611	....	4.83550267	68470.369	42.54
110	Wachusett	89 46 38.026	+ 1.453	39.479	7.846	4.91316518	81877.614	50.87
	Mt. Tom	33 28 40.690	+ .066	40.756	....	4.65479746	45164.526	28.06
	Monadnock	28 05 25.297	+ .483	25.780	....	4.79754469	62740.025	38.98
111	Wachusett	132 05 49.873	+ .208	50.081	5.334	4.99506683	98870.523	61.43
	Bald Hill	19 48 48.820	+ .653	49.473	....	4.65479746	45164.526	28.06

APPENDIX No. 22.

ON THE PLANE-TABLE AND ITS USE IN TOPOGRAPHICAL SURVEYING.

[INTRODUCTORY NOTE.—The plane-table is used in the Coast Survey as the principal instrument for mapping the topographical features of the country, and is universally recognized as the most efficient and accurate means for that purpose. Its application under various conditions, the methods of its use, and styles of topographical representation, have received a great development in the practice of the topographers of the Coast Survey, and special acknowledgment is due in this respect to the comprehensive views, practical tact, and elegant taste of Assistant H. L. Whiting, whose efforts have established the high standard of topographical maps recognized in the Coast Survey. In order to meet the frequently expressed want of a treatise on the plane-table and its use, which does not appear to be supplied by any existing book in our language, the following essay has been prepared for this report by Assistant A. M. Harrison, who acknowledges his indebtedness to many of his colleagues for contributions and aid in its preparation. The chapter on the three-point problem has been supplied by Mr. Edwin Hergesheimer.]

The following description of the plane-table, in the shape in which it is at present employed upon the Coast Survey, and notes upon its use, are given as the results of a long experience of its good qualities on that work. Being the best instrument adapted for topographical purposes, it is desired to supply a want left by the very inadequate notices given of it in most American and English works, and to furnish topographical surveyors with a practical manual of its use. It may seem in some cases somewhat amplified, but those more familiar with it will overlook details intended for the benefit of beginners.

The invention of the plane-table is ascribed to Prætorius in 1537, but the first published description appears to be that of Leonhard Zubler, in 1625, who ascribes the "beginning" of the instrument to one Eberhart, a stonemason. From this time forward it has received successive improvements, chiefly from the Germans and French, until it has reached its present form, which seems to be in keeping with the existing state of science.

Description.—Topography is a more or less detailed representation, in the form of a map, of a certain area of ground, on a specified scale or proportion of nature, mechanically constructed by the measurement of angles, direct linear measurement, and tangential lines. In plane-table practice these are drawn in pencil upon the paper which is spread upon the table, and the details are filled in according to established conventional signs. The work is so conducted that the required figure is obtained in the field at once by the simultaneous measurement and plotting of the angles; and while it is done with as much accuracy as it could be plotted with a protractor, errors of transfer are avoided and much time saved.

The plane-table at present in use by the Coast Survey (see Sketch No. 30) is composed of a well-seasoned drawing board about thirty inches in length, twenty-four in width, and three-quarters of an inch thick, with bevelled or rounded edges. It is commonly made of several pieces of white pine, tongued and grooved together, with the grain running in different directions to prevent warping. It is supported upon three strong brass arms, to which it is attached by screws passing through them and entering the under side of the board, the three holes for the reception of the screws being guarded by brass bushings, and situated equidistant from each other and from the centre of the table. By means of these screws the board can be removed at will.

The arms rest upon the sloping upper face of a rather flat hollow cone of brass, to which they are permanently fixed. Upon its lower edge or periphery this cone is fashioned into a horizontally projecting rim, the inferior face of which is as nearly as possible a perfect plane, and this in its turn rests upon a corresponding rim of a somewhat greater diameter projecting slightly beyond it. This second rim forms the upper and outer flange of a circular metal disk in the form of a very shallow cylinder. The inferior face or plane of the upper flange or rim has, at its contact with the superior face of the lower, a horizontal rotatory movement about a common centre, which is the centre also of the instrument, and the two are held together by means of a solid conical axis of brass extending upwards from the centre of the inner face of the lower disk. A socket of similar shape fits exactly over this axis, projecting downward from the inner side of the apex of the conical or upper disk. The two plates are held together by means of a mill-headed screw capping the cone from the outside, and which can be loosened or removed at pleasure.

A tangent screw and clamp fastened to the edge of the upper rim permit, when loose, the revolution of the table about its centre, and, when clamped to the lower limb, hold the table firm while the tangent screw gives a more delicate movement.

Three equidistant vertical projections of brass grooved on the under side, and cast in one piece with the under face of the lower disk, extending from the periphery towards the centre, rest upon the points of three large screws which come through a heavy wooden block below. This block, which is the top of the stand and is approximate in form to an equilateral triangle, is made of three pieces or horizontal layers, and is two and a quarter inches thick and very strong.

The three screws last mentioned have large milled heads, are quite stout, and play through the block from below by means of brass female screws let into it. They are the levelling screws of the instrument and are equidistant from its centre.

Upon the under side and centre of the lower metal disk is a socket containing a ball with a brass arm, which projects through the centre of the block from beneath. The lower end of the arm is threaded, and upon it plays a female screw with a large milled head, which can be relaxed or tightened at pleasure. This screw clamps the whole upper part of the instrument to the stand; it is loosened only before levelling, and kept securely clamped at all other times.

The block is supported upon three legs, and with them forms the tripod or stand of the instrument, the legs being of such a length as to bring the table to a convenient height for working, and so arranged as to be taken off at will, or closed so that their iron-shod and pointed ends can be brought together or moved outward, as may be required. For lightness the legs are generally made open through the middle of their length, though sometimes they are solid, and each one is fashioned at the top into a cylindrical form with an outer flange, the cylinder fitting into a groove on the under side and near the edge of a truncated vertex of the block. The flange, by coming in contact with the lower edge of the block, prevents a too great spread of the legs. A brass screw, which is connected at right angles with the middle of a movable bolt running through the axis of the cylindrical head of the leg and projecting through a hole in the block, is fastened above by a female screw with a large milled head.

A pair of compass sights or a watch telescope has sometimes been attached to the under side of the board of the plane-table. When the table has been put "in position," the watch telescope is directed to some well-defined object, and by after reference to it any movement which may have taken place out of position in the table during its use can be detected and adjusted. This, however, is but a complication of the instrument, and the same purpose can be more readily served by the alidade itself. The watch telescope has not been used in Coast Survey work.

Rollers have been attached to the under side of the table, taking the place of clamps for holding the map in its place; but these are very liable to get out of order, and are not regarded with favor by the best topographers.

The alidade consists of a brass rule about twenty-two inches long, having a circular level on its upper face. Near the middle of the rule is a perpendicular cylindrical column of brass called the "standard," surmounted by two square brass plates joined by screws, and supporting horizontally a conical journal, through which extends a closely fitting cone of brass, coming from and attached to the side of the telescope. This cone forms the axis of the vertical movement of the telescope, and is secured at the extremity by a screw which holds it in its place. The telescope itself has the usual cross-hairs and means of focal adjustment.

A transverse level is fastened to the edge of the upper of the two plates at the top of the standard by means of adjusting screws.

The telescope is so placed that its line of collimation is above and in the same vertical plane with the fiducial edge of the rule.

A vertical arc with a tangent screw and clamp is attached to the telescopic side of the lower brass plate, and, with a vernier which moves in arc as the telescope is raised or depressed, is used in the measurement of vertical angles for heights.

A small strip of brass is sometimes attached by means of horizontal hinges to the edge of the rule, after the manner of the ordinary parallel rule, for the purpose of obviating the necessity of watching the exact contact of the edge of the rule with the point while sighting; but, as it is liable to the same objection as that instrument, it has not come into general use.

A *declinatoire*, consisting of a rectangular metal box containing a needle so arranged that when pointing north it is parallel to the outer straight edge of the box; a scale of equal parts of brass or German silver; a set of metal clamps for fastening the map to the table; a pair of sharp dividers; India-rubber, pencils, and a pen-knife, complete the list of essentials for prosecuting plane-table work.

ADJUSTMENTS.—From the nature of the service in some sections of the country the plane-table is often necessarily subjected to rough usage, and there is a constant liability to a disturbance of the adjustments; still, in careful hands, a well-made instrument may be used under very unfavorable conditions for a long time without being perceptibly affected. One should not fail, however, to make occasional examinations, and while at work, if any difficulty be encountered which cannot otherwise be accounted for, it should lead directly to a scrutiny of the adjustments.

1. *The fiducial edge of the rule.*—This should be a true, straight edge. Place the rule upon a smooth surface and draw a line along the edge, marking also the lines at the ends of the rule. Reverse the rule, and place the opposite ends upon the marked points, and again draw the line. If the two lines coincide, no adjustment is necessary; if not, the edge must be made true.

There is one deviation from a straight line, which, by a rare possibility, the edge of the ruler might assume, and yet not be shown by the above test; it is when a part is convex, and a part similarly situated at the other end concave, in exactly the same degree and proportion. In this case, on reversal, a line drawn along the edge of the rule would be coincident with the other, though not a true right line; this can only be tested by an exact straight edge.

2. *The level attached to the rule.*—Place the instrument in the middle of the table and bring the bubble to the centre by means of the levelling screws of the table; draw lines along the edge and ends of the rule upon the board to show its exact position, then reverse 180°. If the bubble remain central, it is in adjustment; if not, correct it one-half by means of the levelling screws of the table, and the other half by the adjusting screws attached to the level. This should be repeated until the bubble keeps its central position, whichever way the rule may be placed upon the table. This presupposes the plane of the board to be true. If two levels are on the rule they are examined and adjusted in a like manner.

Great care should be exercised in manipulation, lest the table be disturbed.

3 *Parallax.*—Move the eye-glass until the cross-hairs are perfectly distinct, and then direct the telescope to some distant well-defined object. If the contact remain perfect when the position of the eye is changed in any way, there is no parallax; but if it does not, then the focus of the object-glass must be changed until there is no displacement of the contact. When this is the case, the cross-hairs are in the common focus of the object and eye glasses.

4. *To make the line of collimation perpendicular to the axis of revolution of the telescope, and the axis of revolution parallel to the plane of the rule.*—The instrument is set up and carefully levelled, and the cross-hairs directed to a plumb or other vertical line. If the cross-hairs cover the line when the telescope is elevated and depressed, the adjustments are perfect; should they deviate, however, from the vertical line, this error may be attributable to two causes: 1st, the line of collimation is not perpendicular to the horizontal axis; or, 2d, the axis is not horizontal, and consequently not parallel to the plane of the rule. In the first case the motion of the cross-hairs will be in a curve, and, upon being made to cover the vertical line when the telescope is horizontal, will deviate from it to the *same* side both upon elevation and depression. In the second case the movement of the cross-hairs will be in a straight line oblique to the horizon, and, when made to cover the vertical line when the telescope is horizontal, they will, upon being elevated and depressed, appear upon *different* sides of the vertical line. These two cases will be considered separately.

When the construction of the telescope admits of it, the perpendicularity of the line of collimation to the axis may be examined as follows: Direct the cross-hairs to a well-defined, distant object, as nearly upon a

level with the telescope as may be, draw a line along the fiducial edge; then reverse the rule 180°, again placing the edge along this line, revolve the telescope upon its axis and again observe the object; if the cross-hairs cover it, the adjustment is perfect; if not, one-half the error must be corrected by moving the cross-hairs by means of the adjusting screws of the diaphragm, and the other half with the tangent screw of the table, and the operation should be repeated until the adjustment is complete.

In using the method just given it may be taken for granted that the line of collimation revolves in the vertical plane of the fiducial edge, as any error arising from this not being the case would be inappreciable.

After this adjustment the horizontality of the axis should be examined. Direct the cross-hairs to a distant, well defined, elevated or depressed object, having the table carefully levelled; draw a line along the fiducial edge, reverse the rule, and again direct towards the object; if the cross-hairs cover it the axis is horizontal; if they do not, one half of the deviation should be corrected by means of the screws attaching the upper plate to the top of the standard, or by means of the screws attaching the standard to the rule. The level attached to the axis should then be made central.

5. *To make the line of collimation parallel to the vertical plane of the fiducial edge.*—The exact parallelism of these is not absolutely necessary, but it is essential that the deviation should remain constant. This adjustment may be examined by means of two needles stuck in the table. The table is turned so that the needles sight exactly to some distant object; the fiducial edge is then placed against them and the telescope directed to the object. If the cross-hairs bisect it, the adjustment is correct; but if they do not, it can be corrected by means of the screws attaching the standard to the rule.

6. *Zero of the vertical arc.*—When the line of sight is horizontal, the vernier of the vertical arc should read 0°, or the index error should be known. This may be examined by means of the distant sea horizon, or by setting up the alidade so that the centre of the telescope is in the line of sight of an accurately adjusted levelling instrument, and then directing both instruments, while level, to a distant object; if any error be discovered, it may be corrected by setting the vernier at 0°, and adjusting the horizontal wire to the sea horizon or object.

When the above means are not available, the following method may be used: Set up the instrument at a point, measure the angle of elevation or depression of a distant object, remove the instrument to that object, and measure the angle of depression or elevation of the first point. These angles should be equal if the adjustment be correct; and if not equal, the index error will be one-half the difference of the two readings.

The following method of making this adjustment, where you have neither a separate level, a sea horizon, nor an elevation, may be employed: Set up the table and level it carefully on any level piece of ground between two equidistant points A and B, say 600 or 800 metres apart. Determine with the table the difference of level of these two points, and remove the table to A. Measure carefully the distance from the ground to the centre of the axis of the telescope, and add or subtract this from the difference of level of the point B, according as it is lower or higher than A. Set up a target or distinct point at this height at B, direct the cross-hairs upon it, and correct the vernier accordingly.

A longitudinal striding level placed upon the telescope, or a level permanently fastened upon the top of the telescope parallel to the optical axis, and adjusted to the horizontal wire, will give the error at once.

Plane-table.—With regard to the plane-table proper, a disturbance of its good working condition generally arises from accidents resulting from carelessness or from undue exposure of the board to the inclemency of the weather, and where these injuries are of a serious nature the mechanician only can apply the proper remedies. A coating of shellac has been suggested, whereby the shrinkage and warping of the board is said to be prevented "in a very marked degree;" but well-seasoned wood and fidelity in construction must be the main reliance of the surveyor.

PAPER.—In addition to faulty adjustment of his instrument the topographer has an additional source of error to guard against, arising from the expansion and contraction of the paper, due to its hygrometric nature. From the exposure to which a sheet is subject while in use in the field, and the occurrence of almost unceasing atmospheric changes, it can hardly ever be considered for any great length of time as fixed in its relative proportions; and the difficulty is greatly increased from the want of uniformity in this variation in the different parts of the sheet and in different directions.

When points are determined by intersection, the effect of contraction and expansion may be uniform enough to be comparatively unimportant; but in running long traverses without side checks the effect is always felt.

In plotting long-measured distances the most feasible method of correction is to measure a minute of

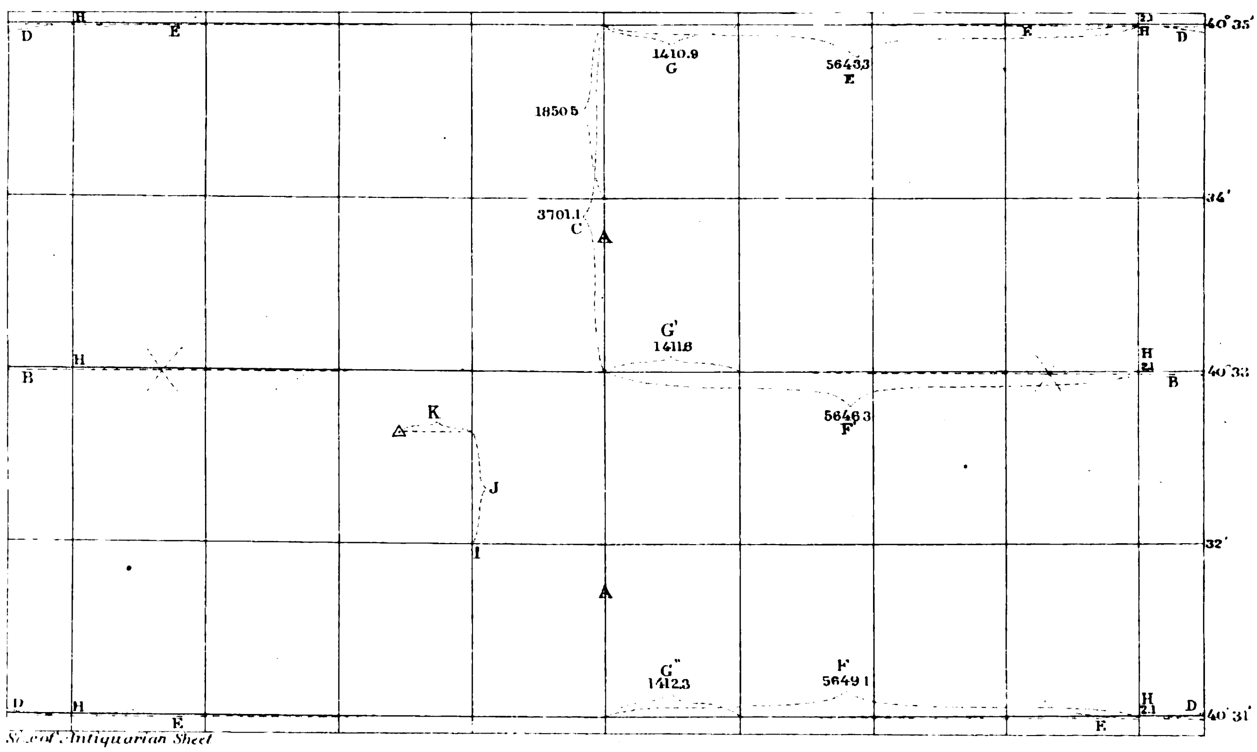


Diagram illustrating the mode of constructing the Conic Projection for Plane Table Work, Scale $\frac{1}{10,000}$
Scale of Diagram, $\frac{1}{80,000}$

latitude near the place of plotting; and as the lengths of all these minutes on the sheet is the same, a comparison with the scale can at once be made and the percentage of error determined. When the sheet has no projection, squares of 1,000 metres constructed upon it will answer the same purpose.

In case of trouble with the points arising from this cause, there is but one remedy, and that is by the system of compensation as treated of in the article on field-work.

SCALES.—The very simple and ingenious decimal system of scales for maps adopted by the French is that in use upon the coast survey. In this system the scale of any map is represented by a fraction, whose numerator is unity and whose denominator is some multiple of two or five, as $\frac{1}{20000}$, $\frac{1}{10000}$, $\frac{1}{5000}$, $\frac{1}{2000}$, meaning that any distance on the map is one twenty-thousandth, one ten-thousandth, &c., of its actual dimensions on the ground. Thus, on a scale of $\frac{1}{10000}$, one decimetre on the map will represent an actual distance of 1,000 metres.

Any other desirable scale can, of course, be used, as a given number of inches to a mile; and in case of triangulating from a base, as in a reconnoissance, no scale even need be adopted. By assuming two points on the sheet as the extremities of the base, and working from them, a correct delineation of the country can be obtained before the base has been measured. After measurement the scale of the map can be ascertained by dividing the length of the base on the map by its length on the ground, both expressed in the same unit.

In those regions where there is much detail, $\frac{1}{10000}$ is the scale generally used for field-work, while in others, where there is but little minute work, $\frac{1}{20000}$ is employed. Less than the latter is never used for field sheets. In some cases, such as surveys of cities, wharves, &c., $\frac{1}{5000}$ may be used; and in certain rare instances, as in surveys for the location of batteries, the mapping of forts and other works, and sites for light-houses, still larger scales are sometimes found necessary.

The diagonal scales of equal parts used on the coast survey with the plane-table, for the purpose of plotting measured distances, correspond with the scales of the maps. They are of metal, and sufficiently hard to stand long wear from the points of the dividers.

PROJECTIONS FOR FIELD-WORK.—The conical projection is that used in the coast survey for field-work.

The orienting of the sheet is determined by various considerations. It should include as many triangulation points as possible; it should duly conform to the position of sheets already surveyed in the same neighborhood; and it should embrace the area of the proposed survey in the manner most convenient for work, and most effective for the artistic appearance of the sheet when finished.

A sketch giving the triangulation points and the approximate shore line being before the draughtsman, he proceeds as follows:

The limits of the sheet having been determined, the middle meridian A (see appended sketch) is located and drawn, and its intersection with the most central parallel determined, at which point the perpendicular B is erected.

The number of minutes of latitude on the central meridian, above and below the central parallel, being known, take the corresponding distance from Table VI, "Projection Tables," C. S. Report, 1853, Appendix No. 39, from under the head "Meridional Arcs," and lay it off (C) above and below the central parallel; and with the same distance as radius, strike arcs D D D D above and below from near the extremities of the perpendicular B. With a well tested straight-edge draw lines E E through the north and south minutes on the central meridian, and tangent to the two arcs D D, to the right and left. This gives three parallel lines perpendicular to the central meridian.

From the same Table VI, from under the head "Lengths of Arcs of the Parallels," take out the value corresponding to the number of minutes of longitude, east and west of the central meridian, and lay off the whole distance F F′ F″ on each perpendicular, taking each distance from its appropriate latitude. Subdivide these into minutes G G′ G″.

For the areas usually covered by plane-table sheets the corrections X, for determining the abscissas from the arcs of parallels, (Table VI, head "Co-ordinates of Curvature,") are inappreciable, and may be disregarded; the ordinates Y only being used. These give the distances to be set off from the lines B E, perpendicularly towards the pole, for each minute of longitude counting from the central meridian. For ordinary field projections of scale $\frac{1}{10000}$ the ordinate of the extreme minute only need be used, and the parallel drawn a right line from the point so found to the central meridian. This ordinate H being set off on each of the parallels, the meridians are all drawn in with a fine ruling pen, then subdivided into minutes, and the parallels carefully ruled in through the points of subdivision.

The projection is verified by applying the measure of a number of minutes of latitude and longitude, and by a comparison of diagonal measurements on different parts of the sheet.

All measurements should be carefully taken from the scale with a keenly pointed beam-compass, and the marks pricked in the paper should be as light as possible to be seen, so as to insure the greatest possible accuracy.

The draughtsman is supplied with a list of triangulation points, which gives their relative distances, their latitudes and longitudes, and also the equivalents in metres of the *seconds* of latitude and longitude, according to which the points are now plotted on the sheet by measuring from the corresponding minutes. Thus in the diagram the distance J represents the seconds of latitude; K, the seconds of longitude of the trigonometrical point.

The accuracy of the plotting is tested by a measurement of the respective distances between the points with the beam-compass, these distances being also given. The degrees and minutes are then plainly marked, usually on the north and east sides of the sheet, at one extremity of each parallel and meridian, the pencil-marks erased, and the projection is completed.

It sometimes becomes necessary to base topographical work upon a detached scheme of triangulation, before the usual astronomical observations have been made. In this case the only elements given are the distances from the points to two projected arcs of rectangular co-ordinates, (which are assumed,) and the distances between the points. The projection for plotting these consists simply of axes of X and Y, so laid on the sheet that it will embrace all the points required by the surveyor, and in the manner most convenient for his work; and the points are plotted from these by the intersection of two arcs with the distances of the points from the axes as radii, either north or south, east or west of the lines of X and Y, as the plus or minus signs given may indicate. The only test is by the distances between the points, and there should be at least two from each. If the work be correctly done, a regular projection can be constructed on the sheet after it is finished and the required astronomical work is completed.

In case it so happens that for some special purpose it becomes urgent to undertake a piece of topography, when neither the data for projections nor co-ordinates are at hand, plotting by distances is the only resource left, and, of course, great care is absolutely necessary.

It has sometimes been found expedient to carry on a plane-table survey in advance of the triangulation, or where the triangulation has not yet been connected with a base. Under such circumstances it is advisable to draw squares of 1,000 or any specified number of metres on the sheet, by means of which the projection can ultimately be laid down correctly.

FIELD-WORK.—*General remarks.*—In organizing a party for field-work it is necessary to have one man to carry the table. His duty is to remain constantly with the instrument, to leave it under no circumstances; and while the topographer is at work he holds the shade to protect the chart from the glare of the sun. In some sections the labor of carrying the table is quite fatiguing, in which case another man should be employed with the shade. He should also keep the pencils sharpened, and sometimes, when a careful person, he levels the table, thus giving the operator an opportunity to glance over the surrounding country. He should always have with him a spare piece of rubber, and one or two extra pencils. Two chainmen are needed, and two or three other men with signals, hatchet, telemeter, and other working apparatus to execute various offices, as they may be required. The maximum number necessary for field-work in a plane-table party on land is five hands, and when using a boat, six. Satisfactory work has been done, however, with three, and on very rare occasions with even two men; but, of course, with less facility. More than five and an aid, when but one table is used, is unnecessary, and a less number is a detriment to rapid execution.

The alidade is carried from station to station by the chief of party, resting on the bend of his arm, or hanging easily at the side, and in handling is to be seized by the lower part of the standard, never by the telescope or rule. Some operators prefer to have it transported in the box by one of the men, and handed to them when the table is set up at a station. It usually weighs 8½ pounds; and there is a fear of its being put out of adjustment or injured by falls on rough ground, or in crossing insecure fences, if carried by hand, and a relief is afforded to the arm by being freed for a while from its weight; but carelessness in taking out and replacing it in the box so many times during the day is quite as likely to disturb its adjustments, as is also the fall of the box, or rudely setting it on the ground; and one soon becomes inured to the weight so as to feel but little inconvenience from it. The metre scale is best fastened under the clamps which hold the paper to the table, where it is close at hand ready for reference. It has been suggested that it would be an advantage to have it engraved upon the rule of the alidade. The pencils, dividers, and India-rubber can be carried

in an outside breast-pocket, the points of the dividers, when not in use, being thrust into the edge of the rubber. A handy and compact arrangement for carrying the scale, pencils, &c., is a russet leather case 10½ by 2¾ inches. It is made large enough to accommodate, on the opposite sides of the scale, when it is in, three or four pencils, and the dividers protecting the points of both; the whole carried in a leather pouch 11 by 4½ inches, slung over the shoulder, the pouch accommodating also note-books for sketching, table of heights, extra pencils, and rubber; everything being at hand and well protected. When the table is set up the dividers and pencils are taken from the case and laid upon the table, and the scale drawn out as needed. Some topographers object to carrying the scale upon the table under the clamps, because it is liable to soil the paper, to drop out in passing from station to station, is not always in the most convenient place for use, and sometimes interferes with the play of the alidade.

It is well to have ready a light India-rubber cloth cover to slip over the board in case of a sudden shower, as well as to protect the paper from the dust on the roads, mud in swampy ground, or water where a boat is used in going from one station to another. The sides of the sheet where they are turned under the table and come more or less in contact with the coat of the observer, should be protected by strips of paper about four inches wide, and six inches longer than the side of table, so as to fold under it and clamp on with the sheet itself. A plan followed by some topographers is to cover the whole sheet as exposed on the table with their paper, tearing it away at those points only where they are at work, and covering again by pasting on patches as soon as finished, thus protecting as much of the sheet as possible.

The plane-table must never be rudely handled, never roughly set on the ground, nor carried heedlessly through woods or swamps; and the weight of the body or arms should never rest upon it. Instructions should be given the men that, under no circumstances, except in cases of threatened danger, should the table or instruments connected with it be touched during the temporary absence of the topographer.

Preliminary work.—As an indispensable preliminary to the operations of field-work, the topographer must assure himself of the correctness of the plotted points on the sheet, by an examination of them in the field, either by actual occupation of each one, or of a sufficient number to embrace them all in two or more lines of observation. When this has been done, and the points found correct, or properly adjusted, as shown further on, the regular survey is commenced.

It is very rare that the number of triangulation points furnished, or their positions, are such as to suffice for carrying on an extended survey without the aid of intermediate points. These are to be determined by the plane-table; and this can be done over a whole or a portion of the sheet, either before any filling in of the topography is executed, or during the progress of the work, depending much upon the character of the country and the skill and judgment of the topographer.

Sometimes, from lack of natural objects, it is found advisable to go beforehand over the country and locate signals in suitable points for subsequent determination and use. In the location of signals, either as permanent points or simply for temporary forward lines, a great deal depends upon the good judgment of the person placing them. Two purposes are to be subserved; first, the seeing of sufficient known points to give a good determination; and, second, to command a view of as great an area of country, and as many natural and artificial features for filling in the topography, as possible. It should be remarked, also, that in the course of prosecution of the regular work, no favorable opportunity must be allowed to pass for locating a signal or determining a point which may at some future time be of service. Advantage should be taken of open places in the woods commanding roads or ravines. Piers or draws of bridges, or piles, giving lines up and down streams, with precipitous or bluffy and woody banks; trees of unusual appearance in prominent positions, or bearing flags placed upon them for the purpose; points of rock, off-shore or otherwise; lightning-rods, cupolas, weather-cocks, chimneys of factories, and other peculiar and marked objects come within this category. In fact, it may be set down as a rule, that well-determined signals located at convenient distances over the sheet are more likely to be too few than too frequent.

Signal poles should be straight and perpendicular, the flags upon them adapted in color to the background against which they will be seen when observed upon, protected from cattle in settled districts by stones piled about their bases, or earth thrown up. They should also be well marked with pegs, or by measurements to neighboring permanent objects, so that in case they are disturbed their positions may be found.

It is taken for granted that some facility in the manipulation of the table is already arrived at, as well as a knowledge of conventional topographical signs, (see sketch No. 32,) and the application of them; it being merely necessary to remark that, on maps of a large scale, it is required to plumb the plotted point exactly over the station, although on the usual field scale an approximation with the eye is all that is requisite; and

that all lines should be drawn lightly and carefully close to the edge of the rule with a finely sharpened hard pencil; and that in sketching one somewhat softer is used. If the table and alidade be in proper condition, the contact of the fiducial edge with the paper will be perfect throughout its whole length; and in drawing a line along the edge care must be taken to preserve the same inclination of the pencil, and to avoid a "shoulder" in the pencil itself. If the rule be at all raised from the paper at any part, still greater care is to be observed lest the point of the pencil should run under the edge and thus deviate from a straight line.

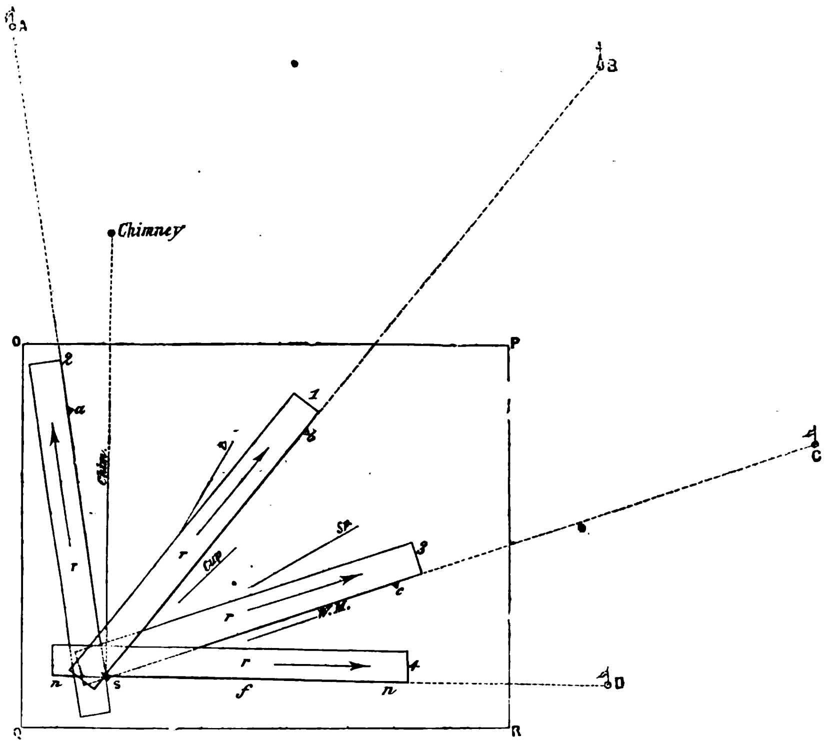
It should be well for the beginner to learn to observe with his left eye as well as the right, for obvious reasons.

The instruments should be kept scrupulously clean and free from sand or grit. An occasional taking apart of the table and cleaning with soap and water, using soft linen rags for the purpose, will be found necessary; and after being oiled and put together, it should be wiped thoroughly dry. The cleaning should not be intrusted to any person unaccustomed to the handling of instruments, and work with the table should cease the moment the presence of any foreign substance between the surfaces which play upon each other is suspected.

In observing upon signals which are not perpendicular, the sighting should be as nearly as possible upon the base of the pole.

Field practice.—Topographical points can be determined by three methods, viz: "prosection," "resection," and measured distances. In the first of these the point must be seen from two or more occupied points in suitable positions, with regard to the point to be determined; in the second it must be occupied; and in the third, there must be a direct measured line, with an established direction from the occupied point. These methods of determination, and the incidental operations which accompany them, will now be considered.

Fig. 1.



Let O, P, Q, R, Fig. 1, represent the board of the plane-table, upon which is spread the topographical sheet; the plotted triangulation point *a* upon the sheet representing the signal A upon the ground; *b*, the spire B; *c*, the signal C; and *s*, the station S; the small letters on the sheet representing the centres of the signals on the ground, which are referred to by corresponding large letters.

The table is first placed approximately level over the occupied station S, and put in position, also approximately, by the eye, so that the plotted points on the sheet are in range with the station S and the signals

or objects they represent in the field. Then plumb the point *s* over the station S, fixing the legs of the table firmly in the ground; place the alidade upon the table so that the rule shall extend across its centre; loosen the large milled head screw projecting below the top of the stand, and by means of the levelling screws bring the bubble of the circular level on the rule to the centre. Place the alidade at right angles to its first position upon the board, repeat the operation, clamp the large screw again, and the table is level. Now free the tangent screw by loosening its clamp, place the edge of the rule *r* upon the occupied point *s* and the point *b*, the telescope being directed towards the spire B, as shown by the arrow-head in the figure, and revolve the table horizontally about its centre with the hands until B is seen in the field of the telescope; clamp the tangent screw and turn it till the intersection of the cross-hairs bisect the top or centre of the spire B. The table is now "in position," if the plotted points be correct and the proper objects sighted. In other words, the table is "oriented" when the point observed upon and the point occupied are in the line of sight, the edge of the rule being upon the two plotted points; the one, *s*, perpendicularly over the occupied station, and the other, *b*, the station observed upon. As a test of the correctness of this, place the rule upon the point *s* again, and upon the points *a* and *c* consecutively, and if the two signals A and C are covered by the vertical cross-hair of the telescope, the orientation is assured, and the meridian of the sheet is parallel to that of the earth, all the lines joining the signals and their respective projections being also parallel.

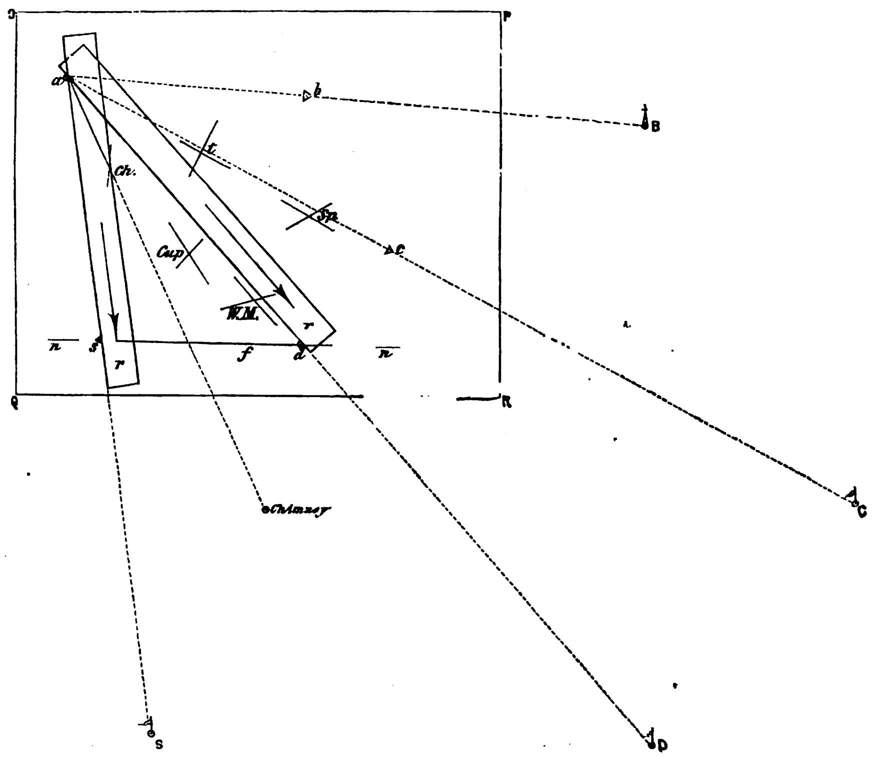
It will sometimes happen that the upper metal disk attached to the table, after it has been clamped and the tangent screw used to put the table in position, has a tendency to spring still further with a sudden movement or slight jerk, and this movement may not occur until impelled by the ordinary working about the table, and pass unobserved by the operator. This may arise from the two disks being screwed too closely together, and the faces in contact not being sufficiently oiled. It is often the source of much trouble to the beginner, and he is unable to discover the cause. It is well, therefore, in orienting the table, when this is suspected, to take hold of the edge of the board with the thumb and finger and spring it very slightly from side to side, in order that the table may settle itself in a fixed position. The cause of the trouble must, of course, be removed on the first opportunity.

The next operation is to "take the forward line" to the next point which it is desirable to occupy or determine, either some natural object which can be occupied, or a forward signal placed for that purpose, say the signal D.

The edge of the rule is placed upon the point *s* and moved about that point as a centre until the forward signal D is covered by the vertical hair, and then a line, *f*, is drawn along the edge of the rule from *s* sufficiently far to reach the estimated distance on the sheet of the point *d*, and at each end of the rule the short check lines *n n* are drawn In the same manner lines to be afterwards intersected should be drawn to such objects as it may be well to determine. To prevent confusion the ends of such lines are marked as in the diagram: *ch.*, chimney; *t.*, tree; *cup.*, cupola; *sp.*, spire; *w-m.*, wind-mill, &c. Tangent lines and lines of radiation to objects comparatively near at hand, to be chained or obtained by the telemeter, as fence corners, &c., should be likewise taken. If the station occupied be in an elevated and prominent position, its height should be observed, both as a guide for putting in the contours at the point and to serve as a point of reference in taking heights at other places, the method of doing which will be given hereafter. The necessary sketching is now done, omitting nothing that can be completed from this point; the alidade removed, the table raised, the signal put up, and the party leaves for the next station. Sometimes it is necessary to start the chain from the station to the forward signal.

When moving from one station to another it is the custom with some topographers to loosen the tangent clamp, with the idea that if the table come in contact with any object while being transported it will revolve and be less liable to injury. This perhaps is true, if the blow comes on the side of the table only.

Fig. 2.

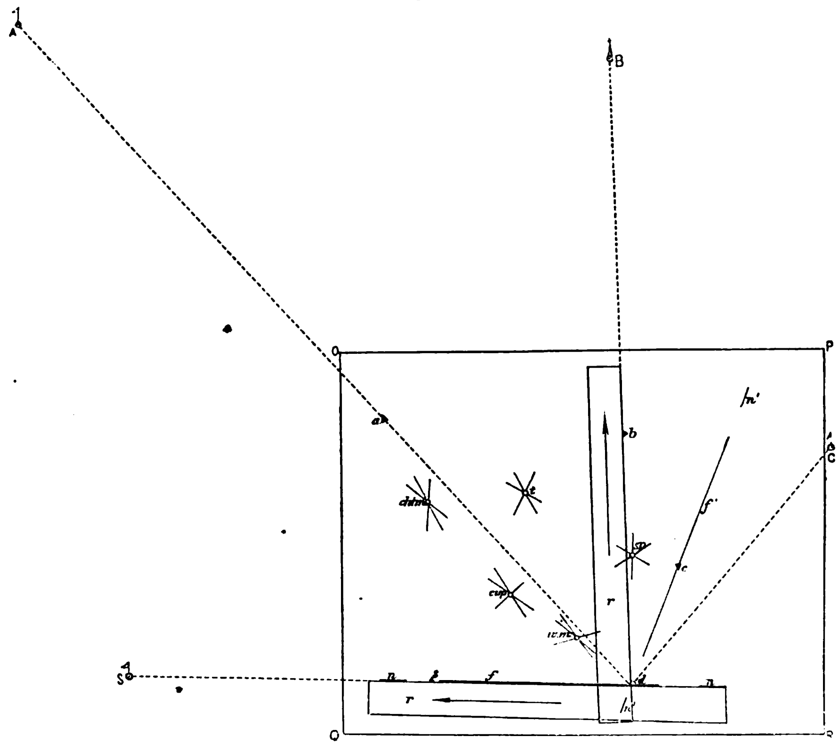


Now, let the letters in Fig. 2 be the same as in Fig. 1. The table is removed to the station A and placed over the point on the ground, put in approximate position, levelled, clamped, and loosened at the tangent screw, as at station S. The rule is then placed upon the line *a s*, the cross-hairs of the telescope directed towards the signal S, and the table brought into position, as before described. Then, keeping the edge of the rule upon *a*, direct the telescope upon the signal D, and draw the line *a d*, intersecting *f*, and determining the position of the point *d* upon the sheet, corresponding to D, and bearing the same relation in position and distance to the points *s*, *a*, *b*, and *c*, as the signal D does to S, A, B, and C. All the other objects to which lines were drawn from *s*, and which can be seen from A, are intersected and determined in the same manner. This is an example of the method of "prosection."

The necessary sketching, determination of height, &c., are executed here as at S, and, indeed, at every point occupied, it being desirable, if possible, never to occupy a station more than once.

The intersection of two lines is not, however, positive evidence of the correct determination of a point. Let us, therefore, proceed to D and again determine it by "resection" from the point B. (See Fig. 3.)

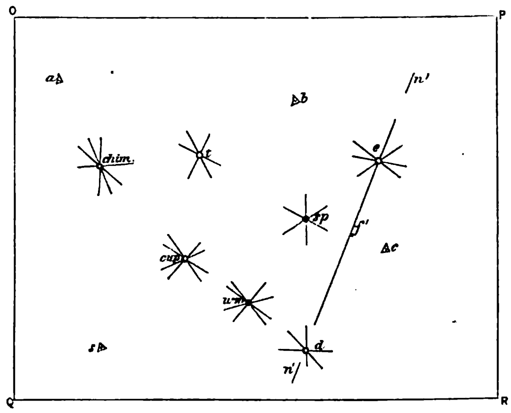
Fig. 3.



The table is placed over the point D, put in approximate position, levelled, &c., as at the other stations. The rule is then placed upon the forward line, *f*, (now called the "back line," as seen from D,) passing through the point *s*, so that the checks *n n* are just visible along the edge, and the telescope directed towards the signal S, as shown by the arrow, and the table oriented. The rule is then placed with its edge bisecting one of the plotted points, such as *b*, which will give a cleanly cut angle (the nearer 90° the better) with the line *f*, and is moved about that point as a centre until the spire B is covered with the vertical hair. A line is now drawn along the edge of the rule, crossing the line *f*. If this line intersects *f* at precisely the same point as the lines *f*, *a*, and *d*, the position of *d* upon the map is assured, and a delicate hole with the dividers should be pricked upon the sheet to fix the point, surrounded by a small circle in pencil. The point may be still further tested by resection from C. If the forward line from *s* has also been chained, the distance taken from the scale and laid off from *s* on the line *f* will afford still another test, and it is quite sufficient if it agree with an intersection where only one can be obtained.

Another forward line, *f′*, is now taken, with the usual checks, *n′ n′*, to the next desirable station, and lines of prosection are also drawn from *d* upon the chimney, wind-mill, cupola, tree, and spire previously observed, as they appear in the telescope, in succession from left to right, and their positions definitely fixed upon the map, pricked through and marked; and these being well determined, can now be used for the determination of other stations. New lines to such other objects as may be thought necessary should be taken, as well as tangent lines, and then follows the sketching to fill in the details about the station.

Fig. 4.



The table is now removed to E, Fig. 4, (which it was thought unnecessary to mark on the figure,) through which the forward line from d is supposed to pass, and is placed over the station; and the point e, representing the projection of the signal E upon the map, is determined by resections by the use of the line f' and the points s, a, b, and c, although the latter two are not absolutely necessary. The spire and tree may also be used for this purpose. Those points which, owing to acute intersections, have been insufficiently determined, as the chimney, cupola, and wind-mill, are again intersected. Other prosecting lines are taken from e upon other points which present themselves, the necessary sketching made, and a new forward line taken to the next station.

During all these operations occasional recurrence should be had with the alidade to some established point to assure the immobility of the table, or to correct any deflection from the true position which may have taken place.

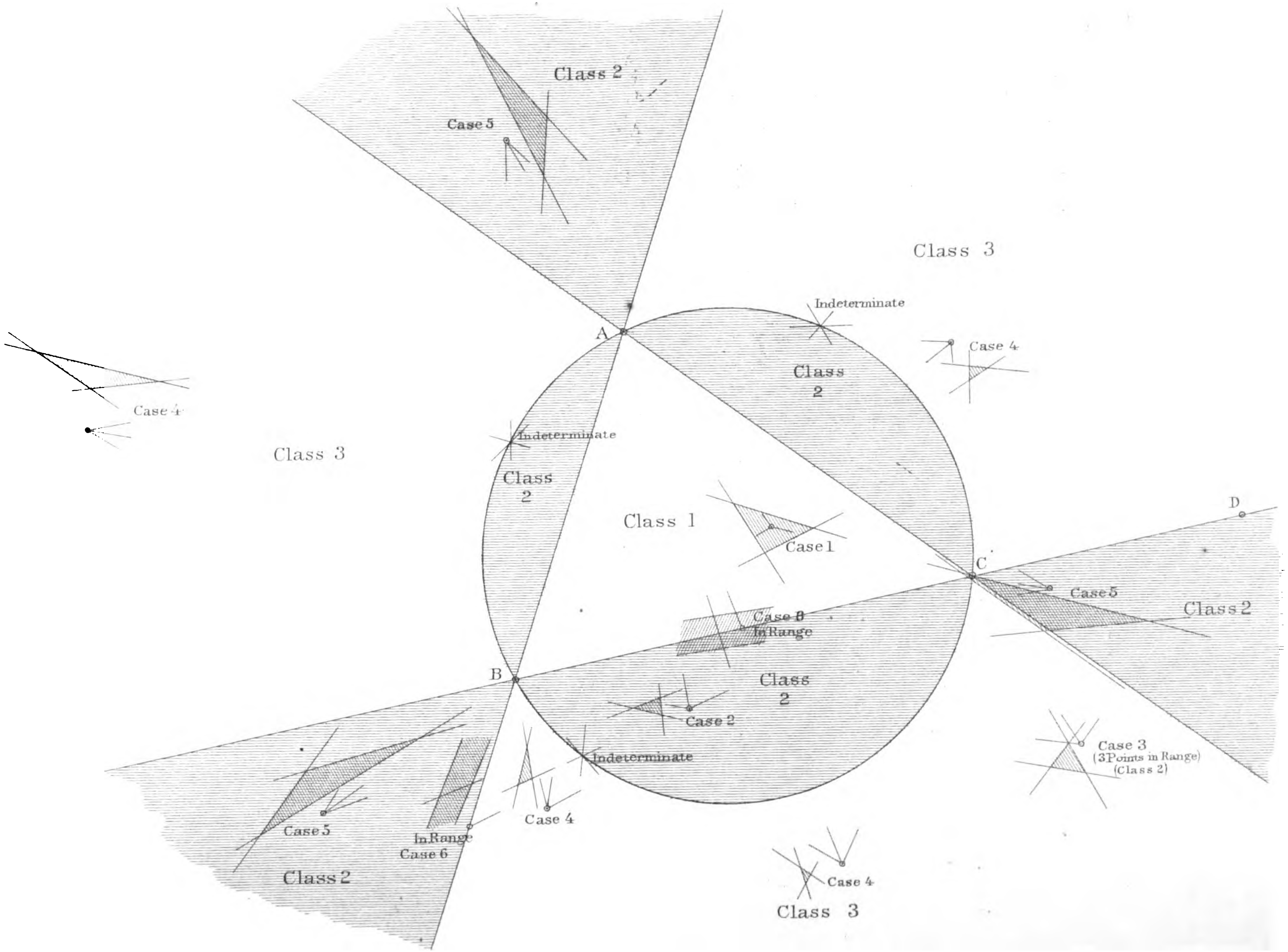
If upon going to a forward signal or object to which a line has been taken it is found that it cannot be occupied, or that it is in such a position that a sufficient number of points cannot be seen from it, or, for any reason, it does not answer the desired purpose, a point in range between the two stations, or upon the prolongation of the line connecting them, can be occupied. Getting into line between two stations is performed by two persons standing facing each other, about thirty metres apart, and as nearly on the line as possible, one of whom sees the back and the other the forward signal. Each then moves alternately to the right or left, as directed by the other, until each signal is in line with the person whose back is towards it, as seen by the person facing it. The table can then be readily placed anywhere on the line. A position for a point beyond the forward signal may also be found by simple alignment with the two signals.

When by accident in drawing a forward line from an occupied point, near which upon the sheet is plotted another or several other points, the rule is not set upon the point occupied, and the error is not manifest until the forward signal is reached, instead of going back to take the line over and draw it from the last station, it can be constructed by drawing from the correct station a parallel to the false line.

Points and lines.—The accuracy of the work on the topographical sheet is primarily and mainly dependent upon the correct determination of points, and a want of an exact knowledge of the capabilities of certain points already determined to ascertain the observer's position upon the sheet, as well as the positions of other points, is one of the greatest sources of trouble and error to a beginner. When a survey is commenced with slightly faulty points, and uncompensated as the work proceeds, the scale upon which it is executed becomes variable, and consequently erroneous.

When, as we have seen, a triangulation point is occupied, and lines drawn from a number of other plotted points with the table in position intersect perfectly at that point, the position is assured; but when they do not thus intersect, the cause of the difficulty may be found either, 1st, in errors of triangulation or computation; 2d, in a faulty projection or plotting of the points; or, 3d, in the unequal expansion or contraction of the paper. The first two, when at all great, can only be corrected by a revision of the work of triangulation and projection; and the latter, if not sufficiently large to warrant an entire rejection of the sheet, can be remedied only by the judicious action of the topographer, with the plane-table, in the field.

When the points disagree within quite moderate limits, the practised hand can, by distributing the error among the points in the proportion of their distances from the occupied point, so reduce the effect of the sum



Class 2
Case 5
Class 3
Indeterminate
A
Case 4
Class 2
Case 4
Indeterminate
Class 3
Class 2
Class 1
Case 1
D
C
Case 5
Class 2
Case 6
In Range
B
Class 2
Case 2
Indeterminate
Case 3
(3 Points in Range)
(Class 2)
Case 5
In Range
Case 6
Case 4
Class 2
Case 4
Class 3

of these distributed errors on the position of the occupied point that he may be safe in considering positions determined from his point, so corrected, as more accurate and trustworthy than the plotted points themselves, and use them as such. A maximum error of twenty metres on a scale of $\frac{1}{10000}$ can generally be reduced at the point of intersection to an almost, if not quite, imperceptible quantity.

The topographer should be very chary in rejecting points as unfit for use. No matter what the apparent disagreement may be, one should not hastily throw aside one set of points and accept another because one set *appears* to agree and the other to disagree. But the positive occupation of a series of points of whose accuracy you thus become sure, and of another series of whose inaccuracy you are equally satisfied, renders the preference of one set over the other at times not only permissible but obligatory. It should always be remembered that absolute and careful investigation in the field, and close examination of the projection, plotting, and data of triangulation ought to be made before any point or set of points is condemned.

THREE-POINT PROBLEM.

It is often expedient to set up the table in position at an undetermined point without any back line on which to set. With three signals in view whose positions are projected on the map, the table can be oriented and the point determined by means of the well known "three-point problem."

The table is brought into approximate position by the eye or declinatoire, and, not being properly oriented, the lines drawn from the three projected points will not intersect in one point, except when all four are on the circumference of a circle. In this case the "two-point problem" is available. Except in this case, however, the lines will form a small triangle, called the triangle of error, or two of them will be parallel, intersected by the third. The position of the true point can then be determined geometrically from these several intersections, and is always at the point of intersection of arcs of circles drawn through each two points and the point of intersection of the lines drawn from them; but the construction of these arcs is inconvenient in the field. More practicable modes of locating the point sought will be given in their order.

In the classification given below, based upon the locality of the true point in relation to the triangle of error, the triangle formed by the three fixed points is called the *great* triangle, and the circle passing through the same points, the *great* circle.

Class 1.—When the point sought falls within the great triangle, the true point is within the triangle of error. (Case 1.)

Class 2.—When the point sought falls within either of the three segments of the great circle formed by the sides of the great triangle as chords, (Case 2,) or without the great circle and within the sector of the opposite angle of either angle of the great triangle, (Case 5,) the true point is on the side of the line from the middle point opposite to the intersection of the lines from the other two points. This also includes Case 3, where the three fixed points are in a straight line, in which case the points are considered as being in the circumference of a circle of infinite diameter, and the true point always lying in one of the segments of the great circle.

Class 3.—When the point sought falls without the great circle and within the sector of either angle of the great triangle, the true point is on the same side of the line from the middle point as the intersection of the lines from the other two points. (Case 4.)

In case the point sought falls on the range of any two of the points, and the table is deflected from true position, the lines from the two points will be parallel, intersected by the line from the third point. But this range can always be determined by alignment, the table set in position on the range, and the point occupied determined by resection on the third point. (Case 6.)

In case the point sought falls *near* the range of any two of the three points, the lines from the two points are so nearly parallel that their intersection falls off the table, but the relation of the true point to the triangle of error is in no way changed.

The accompanying diagram, by E. Hergesheimer, of the Coast Survey, shows the fields embraced by the classes given above, also the location of each of the cases included in those classes.

A point on the circumference of the great circle being indeterminate, it is apparent that a determination should never be attempted in close proximity thereto.

The following cases are believed to include all possible conditions of the relation of the position of an undetermined point to three fixed points. The surveyor is supposed to face his signals and the directions right and left given accordingly:

Case 1. (Figure 1, Plate 31.)—When the point sought is within the great triangle the true point is within the triangle of error.

a b c are the projected points, and *ab ac bc*, the false intersections from them forming the triangle of error.

Rule.—If the line from any one of the points falls to the right of the intersection of the other two, turn the table to the left, and if to the left, turn it to the right.

When the point sought is without the great triangle the true point is also without the triangle of error, and is situated to the *right* or *left* of it, according as the table is out of position to the *left* or *right*.

CASE 2. (Figure 2, Plate 31.)—When the point sought is without the great triangle and within the great circle, the true point is without the triangle of error, and the line drawn from the middle point lies between the true point and the intersection of the other two lines. This also includes Case 3, (Figure 3, Plate 31,) which rarely occurs in practice where the three points are in a straight line.

Rule.—If the line from the middle point is to the right of the intersection of the other two, turn the table to the right, and if to the left, turn it to the left.

CASE 4. (Figure 4, Plate 31.)—When the point sought is without the great circle, and the middle point is on the far side of the line joining the other two points, the true point is without the triangle of error, and upon the same side of the line from the middle point at the intersection of the other two lines.

Rule.—If the line from the middle point is to the right of the intersection of the other two, turn the table to the left; and if to the left, turn it to the right.

CASE 5. (Figure 5, Plate 31.)—When the point sought is without the great circle, and the middle point is on the near side of the line joining the other two points, the true point is without the triangle of error, and the line drawn from the middle point lies between the true point and the intersection of the other two lines.

Rule.—If the line from the middle point is to the right of the intersection of the other two, turn the table to the right, and if to the left, turn it to the left.

CASE 6. (Figure 6, Plate 31.)—When the point sought is on the range of either two points, and the table deflected from true position, the lines drawn from these points will not intersect, but will be parallel, intersected by the line drawn from the third point; the true point is then between the two parallel lines.

Rule.—When the line from the right-hand station is uppermost, turn the table to the right, and when that from the left hand is uppermost, turn it to the left.

Practicable modes of determining the position of a fourth point by resection upon three fixed points.

1st. *Lehmann's method.* (Figure 7, Plate 31.)—This method is based upon the fact that the point sought is always distant from the three lines drawn from the three fixed points in proportion to the distances of the latter from the point occupied.

A B C are the projections of the three signals from which it is desired to determine by resection the position of a fourth point D. The table being out of position to the right, the triangle of error formed by the three lines from A B and C is *ab ac bc*. The true point occupied lies at D, being at the intersection of the circles AB *ab*, AC *ac*, BC *bc*. Now, if perpendiculars be drawn from D to the lines drawn from A B and C we shall have

$$Da : Db :: DA : DB \text{ or } Db : Dc :: DB : DC.$$

The relative distances of the point occupied from the three signals must be estimated and the point located in reference to the three lines from A B and C accordingly.

Netto's method. (Figures 8, 9, and 10, Plate 31.)—This method of determining the true position from the false intersections is ingenious and of much practical value.

The table not being properly oriented, and having resected upon *a b* and *c*; we have the triangle of error $e\ e'\ e''$. Now, by the Lehman method, judge of the position of *d*, (the point sought.) Set the alidade on *db* and revolve the table so that the line of sight passes the signal B. Resect again on *a b* and *c* and we have the triangle of error $g\ g'\ g''$. Join *e* and *g*, and through both points draw parallel lines *i i* and *k k*. Lay off $ei = ef$ and $gk = gh$. Join *i* and *k* and the intersection *l* lies in the line of sight from the true point to the middle point *b*. Set on this line, resect upon *a* and *c*, and *d* is the point sought.

If the two triangles of error are situated on the same side of the true line of sight to the middle point, the parallel lines are set off on one side of *eg* only.

The triangles of error $e\ e'\ e''$ and $g\ g'\ g''$ are always similar $\llcorner g'' = \llcorner e'$, $\llcorner g' = \llcorner e''$, $\llcorner g = \llcorner e$, and as the two points *e* and *g* are always in the circumference of the same circle, if the table is deflected equally on the opposite sides of the true line of sight to the middle point, the triangle of error will be equal and $ef = gh$. On the true line of sight *gh* and $ef = o$.

In the triangles gkl and eil, ii and kk being parallel, $\angle g = \angle e$, $\angle l$ is common, therefore $\angle k = \angle i$ and the triangles are similar, and $el : gl :: ei = ef : gk = gh$.

(Figure 9, Plate 31.)—The point sought (d) must lie in the circle passing through aec, and also through agc. Draw the circle $a\ g\ d\ e\ c\ s$, join s with e and g, then we have

$$\angle dse = \angle dce \text{ and } \angle dsg = \angle dag$$
$$\angle dce = \angle dbe'' \text{ and } \angle dag = \angle dbg''$$
$$\text{Therefore } \angle dse = \angle dbe'' \text{ and } \angle dsg = \angle dbg''$$

also se parallel to bc'' and sg parallel bg''
and the triangles sle and blf are similar,
and the triangles slg and blh are similar;
from which we get $le : lf :: ls : lb$
and $lg : lh :: ls : lb$,
also $le : lf :: lg : lh$ and $le : le - ef :: lg : lg - lh$
that is $el : ef :: gl : gh$ or $el : gl :: ef : gh$.

The amount of the angle at l is always an indication of the value of the determination of the point sought. The more obtuse the angle the better the determination.

BESSEL'S METHODS.

Bessel gives two methods, both based on the same principle.

First method.—(Figures 11, 12, and 13, Plate 31.)

Let a b and c be the projections of the three points observed upon, and ab bc ac, the triangle of error formed by resection upon them when the table is not in position. Lay off bc' on $ba = bc$, extend bc and lay off $ba' = ba$. Call the angle at the intersection $ab = x$, and that at the intersection $bc = y$. At a' lay off toward you $\angle ba'e = \angle y$, and at c' in the same direction $\angle bc'e = \angle x$. The lines so laid off will intersect in e, which lies in the line of sight through the middle point b and the point sought, (d.) By resection upon a and c, the position of the point on this line is fixed.

The solution of this is as follows, (Figure 14, Plate 31,): Lay off at a the angle $bae = \angle bdc$, and at c $\angle bce = \angle bda$, drawing the line bc, $\angle ebc = \angle abd$ and $\angle eba = \angle cbd$. Produce bc to f, so that $bf = ba$, and draw fg parallel to ce. Lay bfg on ba, so that f falls on a and g on h.

Then we have in the quadrilateral $ahbe$ and $abcd$

$$\angle bae = \angle bdc,\ \angle hbe = \angle abc$$
$$hb : be :: bg : be :: bf : bc :: ba : be.$$

The two quadrilaterals are therefore similar, and hence

$$\angle ebc = \angle hba = \angle abd$$
$$\text{and } \angle eba = \angle cbd.$$

Second method.—The plane-table may also be put in position without the use of the points a' and c' (Figures 15, 16, and 17, Plate 31.)

On ac at c lay off $\angle ace = \angle x$, and at a lay off $\angle cal = \angle y$. The lines so laid off will intersect in e, which lies in the true line of sight through the middle point b and the point sought, (d.) Resection upon a and c then fixes the position of d.

The angles e and d of the quadrilateral $aecd$ make up from the construction two right angles; hence a circle may be described about the quadrilateral and we have the periphery angles

$$ace = adb$$
$$\text{and } cae = cdb.$$

This latter method, being simpler, is better than the first, but, under certain circumstances, one may be used when the other cannot. If, for instance, by the last-mentioned manner of construction the point of intersection (e) should fall outside the plane-table, it may possibly be made to fall inside by the first method. Again, if, by the latter method, the angles of intersections happen to be right angles, or nearly so, then the two plotted lines to e become parallel to each other, or nearly so, in which case the first method may be used with advantage.

The best mode of constructing the angles x and y upon ac is with the alidade; directing the line to one of the objects and observing the other object with the alidade set upon the point at which the angle is to be set off. It can also be readily done with the dividers by laying off the chord of the angle.

Should either or both of the angles set off at a and C be so obtuse that the point e falls off the table, a shorter base can be used, drawn parallel to ac, as near to b as may be necessary.

TWO-POINT PROBLEM.

The occasion may arise where it is desirable to place the table in position at a given point, from which point only two determined points are visible. This may be done by the following methods. The first mode, by J. E. Hilgard, of the Coast Survey, possesses the virtue of making no linear measurement, and demonstrates in a very satisfactory manner the power of the table in determining position by resection. (Figures 18, 19, 20, and 21, Plate 31.)

Two points, A B, not conveniently accessible, being given by their projections a b, to put the plane-table in position at a third point C: (The capital letters refer to points on the ground and the small ones to their corresponding projections.)

Select a fourth point D, such that the intersections from C and D upon A and B make sufficiently large angles for good determinations. Put the table approximately in position at D, by estimation or by compass and draw the lines Aa Bb, intersecting in d; through d draw a line directed to C. Then set up at C, and assuming the point c on the line d C, at an estimated distance from d, and putting the table in a position parallel to that which is occupied at D, by means of the line c d, draw the lines from c to A and from c to B. These will intersect the lines d A d B at points a' and b', which form with c and d a quadrilateral *similar* to the true one, but erroneous in size and position.

The angle which the lines a b and a' b' make with each other is the error in position. By constructing now through c a line c d' making the same angle with c d as that which a b makes with a' b', and directing this line c d' to D, the table will be brought into position, and the true point c can be found by the intersections of a A and b B.

Instead of transferring the angle of error by construction with the dividers, it may be done by the use of the table, in the following manner: Direct the line a' b' toward D, and on the line a b sight in a mark, not too near; then turn the table again, so that c d is directed towards D. In this position set the alidade on c, and point it to the mark, when it will make the required angle with the direction c D. Turning now the table until the alidade points again to D, it will be in position.

Another method, by E. Hergesheimer, of the Coast Survey, is as follows: (Figure 22, Plate 31.)

Two points, A and B, not conveniently accessible, being given, to put the plane-table in position at a third (undetermined) point, C.

Set up the table at the point sought as nearly in position as can be done by the eye, and resect upon A and B, intersecting the line bc at c'. The angle $ac'b$ is the true angle at the point occupied, subtended by A B, being the angle of nature actually drawn; therefore, the true point must be on the circumference of a circle passing through abc'. Construct this circle. Measure off a reasonable base, C D, at right angles, or nearly so, to bc, in either direction most convenient. Set up a signal at D, and with the alidade draw the line $c'd$. Remove the table to D, and, by means of a signal at C, (the point sought,) and the line dc', bring the table into a position parallel to that which is occupied at C. With the alidade centring on d, observe the signal B, and draw the line db' intersecting cb at b'. c' b' is the distance of the point C from B, and this distance laid off on the circle $ac'b$ as a chord from b will give c'', the true position of the point C. A fourth point may then be occupied, and by resection upon A B and C the accuracy of the determination of C verified.

Where it is possible to get the two signals A and B in range, it is easy to determine the position of a third point by a mode long practiced by topographers.

Set up the table anywhere on the range line, and, having set up a signal at the point sought, resect upon it, intersecting the range line anywhere, and, by means of the range signal and the line to it, the table may be set in parallel position to that occupied in the range, which is the true position, and the point sought may be determined by resection upon the two fixed points and their projections.

FIELD-WORK

In taking lines of intersection upon a point or object from a series of stations, when these lines do not coincide in one point, as they are usually derived from signals at unequal distances, the error should not be divided equally among them, but in proportion to their lengths.

It should be borne in mind that very short lines from a determined point—as, for instance, to the corners of a fenced road, where the table occupied the centre of the intersection of two roads—may be taken with no apparent error when the table is deflected to some extent from its true azimuth, but that in this case a prolonged line will be considerably out at its further extremity.

A long line should never be obtained by the prolongation of a short one from a back station where there is no small check line, or some other point in that prolongation already fixed.

It will be apparent that the more nearly at right angles intersecting lines cross each other, the more clearly the point will be defined; acute intersections, as far as possible, should be avoided, and, even when they are crossed by a third line at a satisfactory angle, a fourth line, or an accurately chained distance from a well-determined point, is advisable.

The necessity for dependence upon a measured line, with an established direction alone, for position is sometimes unavoidable; but, except for minor details, it should never be resorted to when other means are available. Occasional checks are very important, and, in a finished piece of work, no lengthened consecutive series of chained lines for positions should be trusted without resections for test of accuracy. It is safer to combine both, unless the supply of signals is ample and they are favorably located.

A judicious use of range lines from established points, or signals, will much economize time and facilitate work.

Two range lines from well-determined points are equivalent in value to four insecting lines.

Tangent lines can only be used for determining the edges of woods, bends of streams, sweeps of shore-line, outlines of shoals, small ponds, and the outlines of other objects when in unimportant localities, and are inadmissible for any purpose in which accuracy of delineation is expected, save when they form a polygon, by which absolute convexity at all points is to be represented, and even then the points or objects should be visited and sketched, if possible.

Where the topography surveyed includes the shore-line of a body of water, the hydrographic survey of which is intended to follow the topographical work, as in the Coast Survey, it is the duty of the topographer to locate and determine the shore signals, and it is only necessary to state that they should be so placed as to furnish the hydrographic party with as many points as is desirable for the determination of positions on the water.

It is well to mark all stations occupied along or near the shore by pegs driven into the ground with stones about them, and give their positions upon the tracing furnished the chief of the hydrographic party, and he can then select such as are best adapted to his use.

Natural or artificial objects along the shore, or in plain sight from the water, such as fence ends, rocks, prominent houses, and posts on wharves, &c., should be determined and marked upon the sheet. As some time may elapse between the labors of the two parties, the stations should be well secured above the wash of the tides.

Lines to buoys and other permanent floating objects should be, as far as practicable, taken at the same stage of the tide, or direction of current, or the status of the tide noted at the time of observation.

In the determination and tracing upon the chart of the low-water line, so much in its outline is generally dependent upon the direction and force of the wind that no fixed rules for guidance can be given.

The delineation of the ordinary mean low-water mark should be aimed at, and when it is beyond the reach of the plane-table, and presents no marked points for determination, or is of a character that will not admit of putting up and working the instrument—as along the swampy shores of the south, where the muddy shoals extend far sea-ward, and among the shifting quicksands of our great estuaries and bays—it must be left to be traced by the soundings and tidal reductions of the hydrographic parties.

It is always best to determine the high and low water lines, both at spring and neap tides. Having learned the range of tide the topographer will know how long he can work without error.

Where, on the occurrence of any great or unusual storm or freshet during the working season, the low-water line, which has already been surveyed is found to have changed in form or locality, it should be resurveyed, and both the old and new outlines retained on the sheet, with the appropriate notes.

As a feature which is quite interesting and important under certain circumstances to the hydrographer, low-water springs, having their origin and outlet below the high-water line, should be shown on the chart, where it can be done, in the regular routine of work. All grassy shoals should be delineated. They are always found in water scarcely agitated by waves or currents, and their shape and outline on the channel side is a very marked feature, and a good measure of the power of the current. Eel grasses should also be put upon the map, as indicating an antecedent accumulation of fine sand or soil.

Orientation by the declinatoire or compass-needle, alone, is not reliable, unless for obtaining positions for rough sketching in plane-table reconnaissance, but it may be useful as an adjunct when an operator, in default of sufficient points, desires to obtain an approximate position. It is used by placing the straight edge of the box containing the needle upon a magnetic meridian, previously traced upon the chart, and revolving the table until the needle points to O, or north, on the graduated arc in the end of the box. The magnetic meridian is roughly obtained at any well-determined station, when the table is properly oriented by the use of the declinatoire itself, the meridian line being drawn upon the sheet along the straight edge of the box when the needle points to O.

In sketching or drawing care should be taken not to lessen the size of natural objects, the scale being followed as far as practicable; but in some cases, which will be apparent, it may be desirable to enlarge somewhat, but very cautiously. The topographer should learn to draw from nature readily, and at once, without being obliged to erase or interlineate.

By working carefully at first this will be obtained in due time.

Too frequent use of the India-rubber disturbs the fibres of the paper and renders the subsequent inking less neat and clear. The drawing should be plain and distinct, so as not to be obliterated easily by the movement of the alidade over the paper, but not so dark or heavy as to blur. The object should be solely to represent accurately the surface and elevation of the country surveyed, and it should be easy and natural, and not a stiff copy of conventional signs.

Nothing should be left uncertain or indefinite, to be afterwards puzzled out or guessed at. As far as practicable all work should be drawn in the field under the eye. Sketching and plotting in the office from notes is objectionable, unless the country be near at hand for examination in case of doubt or a defective sketch or of error of chaining.

Too great care cannot be taken in the manipulation of the plane-table. There should be no pressure, and in moving the alidade both it and the arm should always be raised clear of the board, so as not to rub over the surface of the sheet.

The topographer should learn to distinguish, as a matter of economy in point of time, between the relative importance of different topographical features. While it should be the object to do all the work correctly, yet a line should be drawn between the expenditure of time necessary to a correct representation of the thickly-settled streets of a town and the bend of an unimportant creek in an obscure and out-of-the-way swamp. Experience alone can teach a proper discrimination in this respect.

CONTOURS.

If there be any feature which more peculiarly distinguishes one section of a country from another, imparting to it its most striking characteristic, and to which all other accidents of ground are subordinate, it is to be found in the inequalities or changes of the level of the surface, and it is the correct representation of this feature that calls forth the best skill and judgment of the topographer, and upon which the value of a map most materially depends.

Previous to the commencement of work, it is well to become possessed of some knowledge of the country which is to be surveyed. A rapid examination of the ground, by showing whether it lies in regular parallel ridges and intervening valleys, isolated hills, gradually sloping plains, or broken, abrupt, and rocky declivities, and whether partially or entirely open, or wooded, will suggest to the topographer the best method of operation, and enable him to form a general plan of work which will result in economy in point of time, and as a consequence will preserve the continuity of contour from day to day as the work progresses.

By keeping in view the characteristic features of the hills in the section of country under survey, the topographer will be able to give a naturalness to a sheet, which, by a mere formal, though correct, delineation by prescribed rules, he could not obtain. It is to be observed that the elevations and depressions, in their form and course, follow, or rather are a part of a general system of nature, however capriciously detached

localities, or even extended areas may appear to be excepted from the general law. Where these exceptions are found they can usually be traced to some breach of or interference with this law, and will be found to be confined solely to the locality where the disturbing causes operated.

Thus the principal ridges will be found to tend in one general direction, either running parallel with the main range which lies farther off, or forming spurs at right angles to it. Along the coast the latter is generally the case, as we there usually find the spurs, or the extremity of some main prominent inland range. When a single detached hill is found, or a series of them, presenting, as is sometimes the case, so smooth and regular an outline as to be compared to half a watermelon, and apparently located without any reference either in direction or character to the other elevations of the vicinity; and so also when the ground presents the appearance of a confused mass of broken bluffs, rocky faces and cleft surfaces thrown together without any apparent regard to order or regularity, it will be found that the general delineation, when followed far enough, will show that the contours, whatever may be their local complexity and irregularity of outline, follow the same general direction as the main ridges of the sheet. Along the intermediate shores, upon islands, or long arms running far out into the sea, where the sandy knolls, or dunes and ridges, shift or change their outline under the influence of wind and tide, an exception is found which calls for careful delineation, and the peculiar and striking character and forms of these should be portrayed with all possible exactness as an interesting and useful aid in the study of a correlative branch of geodesy.

To the meteorologist and to the physical geographer the careful mapping of dunes is valuable, for however familiar the locality may be, no eye-view can discover those recurring features which are found in the map of an extended district.

If a sandy district is exposed to permanent or prevalent dry winds, travelling dunes will be found; these are distinguished from other hills by the contrast between the *fore slope*, (on the lee side,) which is steep, and the near slope, (on the windward side,) which is gradual. Successive surveys on sandy coasts, where close attention has been given to the contours of the dunes, are of great value for comparison if every detail is carefully given. Even in places where the winds are uncertain, proper contouring discovers dunes which travel along the resultant of the forces, and in the direction of this resultant the great dip of the fore slope is found. For such dunes the several slopes for different points of the compass are equally interesting

On exposed points projecting far into the sea peculiar dunes, called *galls*, are found. They are long ridges of sand, broken by slue-ways. It has been observed that sometimes these slue-ways are parallel. Correct and well contoured topographical maps of the localities where they are found would aid much in a study of this interesting subject. Contours only would discover their order and exhibit the material system, which could not be done by a representation by hachures.

The delineation of bluffs along the shore should also, for like reasons, be carefully executed, and when it is possible, a representation of its slopes should be given. Bluffs, if worn by the waves, will usually exhibit three slopes: 1st, the caving slope at the top; 2d, the talus; 3d, the apron or flat, exposed wholly only at very low tides. The caving slope is sometimes perpendicular where tertiary country is being worn away—never where old dunes are yielding. The talus is usually of selected material—stones, perhaps. The talus and flat are generally wanting in bluffs worn by currents.

As has been said, in no branch of surveying does so much depend upon skill, combined with good judgment and experience, as the faithful representation of hills over an extended and diversified area, and long practice and close observation only can give facility and accuracy in its execution.

Various methods, more or less defective, in presenting a correct idea of elevations and depressions, have been contrived for topographical surveys, but the graphic representation of the successive gradations of level by means of horizontal lines, as at present employed in the Coast Survey, gives the nearest approximation to nature which has yet been devised, and when faithfully executed must necessarily express very nearly, if not exactly, the shape and height desired.

Contours, or horizontal curves, are the outlines of horizontal sections of ground at different elevations, with designated equal intervals between their planes, delineated in their true positions relatively to each other and the rest of the map, and agreeably to the scale of the map itself, or, briefly, a contour is the curve produced by the intersection of a horizontal plane with the surface of the ground.

Perhaps contours may be described more simply as imaginary shore lines formed at stated or regular elevations, by the water which is supposed to rise successively to these elevations over the face of the country.

As each curve has equal vertical ordinates at all points, the elevation or profile of a hill, as well as a model

in relief, can be constructed directly from the map when it is accurately executed on a large scale, without further field measurements.

A profile of a hill is the outline or trace formed with its surface by a vertical plane cutting the hill in any direction.

The annexed diagram shows the profile, through the line A′ B′, of the hill H, as represented on a topographical map. The full parallel lines upon the profile represent successive heights, or sections of the hill of twenty feet, and the broken or intermediate lines, *x x x*, those of ten feet.

A reference to the letters upon the diagram is all that is necessary for a full understanding of the subject; *a* is the shore line or high-water mark upon the map, *x x x* are the auxiliary ten-feet curves, *f′* the coincidence of curves upon the chart at the perpendicular face of the hill, *f* upon the section. This is the only case where contours of different heights run into each other upon a topographical plan. D′ D′ are depressions in the face of the hill represented on the profile by D, D; *d′* is a barranca or dry broken gully, and *c′ c′* a water course.

It will be plain that if we were to suppose the water to rise to a height of twenty feet above the high-water line, or to *h* on the profile, the twenty-feet curve upon the map would then become the shore line and the depression D′ would fill up and become a pond of water; and if the water were to rise to a height of thirty feet, the dotted broken line would form the shore line, and the knoll G would become an island.

Horizontal curves are drawn upon the map with the eye, after having obtained the heights, by means of which their positions are fixed, by the measurements of vertical angles with the arc of the alidade, or in detailed or special surveys with the level. Where the slope is regular and tolerably steep, the tracing of them is attended with but little difficulty; but where the rise is very gradual, giving large horizontal distances between the contours, even when the vision is unobstructed, or where the country is much broken or thrown into irregularly shaped knolls and depressions, presenting an intricate and confused variation of surface, the correct representation is, at times, very perplexing.

As in some instances, owing to the smallness of the angle to be measured, the vertical arc cannot be relied upon for close determination of heights, and it is evident that the nearer to a level a country is, the nearer it is necessary to obtain the exact elevation for the location of the contours, recourse to the level is indispensable. With the beginner the observations for elevation can hardly be too frequent, and he should constantly bear this in mind while at work, as well as the necessity for leaving frequent well-marked points of reference wherever it is practicable, or will serve a useful purpose.

When triangulation points are occupied, or positions are determined by the plane-table preliminary to the regular work—in fact, whenever any station is occupied, its elevation should be taken, as well as those of such other prominent points or objects as may be commanded from it. Then in using these in working by resection, the topographer has necessarily as many points of reference for the determination of height as he has for determining his position.

It is well, also, to get observations for heights as often as possible upon or from the plane of reference or high-water mark, and advantage should be taken, whenever it presents itself, of observing from the shore line in wooded districts upon any detached openings which may present themselves, and also upon rocks or any other natural or artificial objects upon the sides of the surrounding hills.

Where the heights of certain points have been taken by the triangulation party, or a few prominent ones have been determined by the theodolite or level, they should be used as often as possible as points of reference.

When hills are inaccessible, the determination from accessible points of both the positions and heights of objects upon them, such as trees, rocks, stumps, &c., from which the positions and courses of the contours can be determined, should be sought for, and in thick forests the roads, paths, or the dry beds of streams may be found available for the use of either the vertical arc or level.

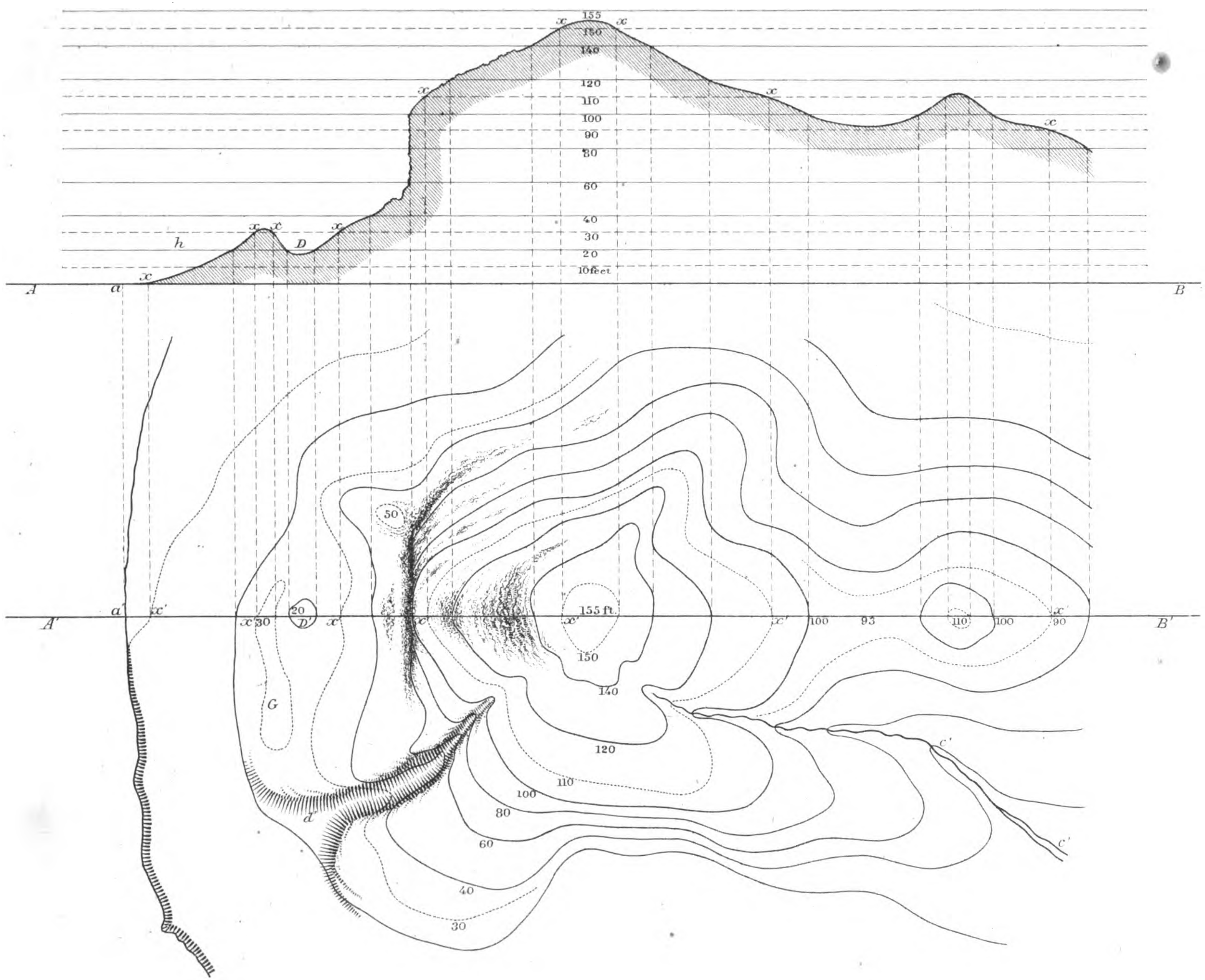
Under certain conditions, as those of densely wooded heights and vales, inaccessible, precipitous ledges and bluffs, &c., the operations of the surveyor are limited to an almost entire dependence upon the eye alone. This cannot be relied upon, of course, and should be avoided as much as possible.

It is customary to represent on the usual Coast Survey field sheets, heights of twenty feet, but occasionally, owing to marked accidents of ground, it is deemed advisable to insert an intermediate or auxiliary contour, the practicability of doing which, however, is sometimes interfered with by the small scale of the map, taken in connection with the exceeding steepness of the declivity, giving rise to a liability of coincidence and confusion. The capability of representation in this respect depends then very much on the general nature and

Diagram illustrating the mode of constructing Profile from Plan

Scale $\frac{1}{10,000}$

Scale of Profile 10 of height to 1 of Base.



abruptness of the hills, as, where very steep, the larger the scale of the map the greater the number of curves which can be shown, as in the French survey of Paris, where equidistant horizontal contours are drawn at every two metres of elevation.

Contours should be filled in from each station while carrying on the regular work, when it is possible to ascertain heights for that purpose, and in selecting positions for forward signals, and in prosecuting the work, reference should be had to the continuous and successive tracing of the contours on the map, both of those which are filled in *at* and those *from* the station, as this will generally prove an economy of time, and the work can be executed with more facility. When the operator is at a station whose elevation has been accurately determined, lines should be taken to objects of equal height in all directions, and marked to that effect, subsequent intersections giving their positions; this will be found of great assistance in running contours and as checks. Care should be taken in sighting to distant objects to allow for the curvature of the earth.

With regard to the method of putting in contours from the base of the hill upward, or *vice versa*, opinions differ, some preferring one course, some another, but it makes but little difference if the starting point be correct. Neither of these systems should be specially adopted, but the circumstances of the other topography should be considered, and they should be worked together to the best advantage, so as to carry on both simultaneously. It frequently happens that a piece of work is done in one part of a sheet, and then it becomes necessary to work in another, in which case the first, where heights are well determined, serves a good purpose as a check in closing.

When the work, as often happens, has been carried on in a wooded country, in a place where observations have not been taken for a long time, then the importance of coming out upon some fixed point is evident.

When this is impossible, as sometimes occurs in the filling in of the topography in dense woods, in a rolling country, and the operator is confined perforce to the roads, frequently with very short sights, and there is no check to come out upon, or when the work closes on the edge of the sheet, the use of the level in the hands of an aid, though consuming time, is indispensable.

The determination of the heights of artificial features, such as fence corners, houses, &c., as an assistance in contouring should not be neglected.

When the contour runs very near any remarkable accident of ground, as a prominent spur or indentation, on general field maps of $\frac{1}{10000}$ scale, a slight deviation above or below its true plane is admissible although it is preferable to represent it by the introduction of the auxiliary curve, as shown in the sketch.

It is very desirable that all features within the twenty feet curves, such as breaks in the ground, isolated boulders, rocks, &c., which cannot be legitimately represented by auxiliary curves, should be shown by hachures or conventional signs. When the rocks have a distinct stratification, or when cleft in certain directions, it should be indicated.

It may happen that at certain points certain small features, which are unimportant in themselves, may interfere with the development of the general form of the contours, or their introduction may tend to produce confusion; these are best omitted, but this omission should be optional only with the practiced hand. It is a dangerous precedent to give latitude in this respect to a beginner.

When there is an abrupt rise, as in low bluffs, railroad embankments, &c., not above ten feet in height, on a scale of $\frac{1}{10000}$, it should be marked by hachures always tapering downwards, and all hachures should, in their direction, follow the downward flow of water or alluvion.

Depressions of the ground in the midst of level tracts, or upon tops or slopes of hills, unless distinguished by ponds or marsh, should be marked with the letter D in red.

The distinct summits of hills should be marked in figures when characteristic or remarkable features of the country.

In measuring for heights or depressions with the alidade the plane-table is carefully levelled and firmly clamped, the telescope is directed towards the point of observation, and moved until the cross-hairs are in the same vertical plane as the observed object. The telescope is then clamped by means of the screw at the top of the arms of the vertical arc, and the central cross-hairs, at or near their intersection, are brought to cover the observed point by means of the tangent screw attached to the graduated arc. The angle read, the distance between the occupied point and the observed point measured on the map, and the height is taken from the table, which is appended.

Example.—Observations for height at an occupied plane-table station.

Stations observed.	Observed angles.	Distance in metres.	Relative height in feet of plane-table station.	Height of observed station in feet.	Height of plane-table in feet.	Corrected heights of ground in feet.
	° ′					
Shore signal, (angle of depression)	1 57	1,756	+197.4	0	4	193.4
Smith's Hill, (angle of elevation)	0 02	940	—2.0	201.3	4	195.3
Black Rock, (angle of depression)	2 13	539	+68.7	126.9	4	191.6
Mean height of station						193.4

Detail of use of table of heights.

Shore signal:

1° 50′ for 1,700 metres	=	179.00 feet.
1° 50′ for 50 metres = 0.1 of 500 metres	=	5.26 feet.
1° 50′ for 6 metres = 0.01 of 600 metres	=	.63 feet.
0° 07′ for 1,700 metres	=	12.10 feet.
0° 07′ for 50 metres	=	.34 feet.
0° 07′ for 6 metres	=	.04 feet.
Total		197.37

In these observations three stations at least should be observed upon when practicable, and the mean adopted. On an instrument at times unavoidably subject to such rough usage as the alidade, the adjustment of the vertical arc should be frequently examined.

A material advantage in the attachment of the longitudinal level to the alidade would be found in the facility by which the instrument could then be used as a level in following outlines of equal elevation, and would be particularly serviceable on gradually sloping ground.

A formula for computation of heights, which may prove of service where no table of heights is at hand, is appended.

When, as is sometimes the case, a surveyor's level is employed, the determination of the position of the level pegs by the plane-table on the sheet is all that is necessary, and the contours can be readily traced.

Barometric heights are admissible for approximate contours in reconnaissance where a general survey only of hills or ranges is expected.

In using the aneroid barometer in ordinary reconnaissance it will suffice to allow ninety-two feet of elevation for every 0.1 of an inch fall of the index. This allowance is for a mean temperature of the two stations of 55° Fahrenheit, and will vary with the temperature.

Leslie's formula, simple and easily remembered, is a good approximation below 2,000 feet, and convenient for aneroid observations, viz: $55{,}000 \times \frac{B-b}{B+b}$ = height in feet, B being the upper, and b the lower, reading of the aneroid. This is likewise for a mean temperature of 55°.

A very convenient instrument for a tolerably close location of contours, when carefully employed, is Locke's hand-level, which can be readily carried in the pocket, it being requisite only to know the height of the eye from the ground, and for the observer to stand equally erect at all points of observation, or to hold the level at a constant height upon a measured staff.

Formula for determining heights by a vertical angle and distance.—The difference of level consists of two parts, that which arises from the angle of elevation above the horizontal plane of the station, and that which is due to the curvature of the earth. The former depends upon the angle and distance, the latter upon the distance and the earth's radius. If a' be the angle of elevation in minutes of arc, d the distance, h the height, then, as the tangent of 1′ is $\frac{1}{3437}$, we have for the first part $h = \frac{1}{3437} a' \times d$, if h and d are both

expressed in the same units of length; but if d is expressed in metres and h in feet, one metre being 3.28 feet, we get $h = \frac{1}{1048} a' d$. For the fraction $\frac{1}{1048}$ we may conveniently and with sufficient accuracy put $\frac{1}{1000}$ less $\frac{1}{20}$ of $\frac{1}{1000}$, and thus find the rule: *multiply the distance in metres with the number of minutes of arc, point off the thousandth part, and subtract the twentieth part of the number thus obtained.* This will give the first portion of difference of height, whether elevation or depression.

The second term, depending on the curvature, varies as the square of the distance, and amounts to 0.22 foot in 1,000 metres, including the effect of ordinary refraction. As with the instruments under consideration extreme accuracy is not attainable, it is plain that for distances under 1,000 metres this term may be neglected. When the distance is greater we have the following rule: *Take the thousandth part of the distance in metres, square the same, having regard to the first decimal figure, and multiply by* 0.22. This term is always positive; if the first term be an elevation, it is increased; if a depression, it is diminished by the second term.

Example.—Distance = 5,500 metres; angle of elevation, 36′.

$\frac{1}{1000} d \times a'$	= 198.000	$\frac{1}{1000} d$	= 5.5
subtract $\frac{1}{20}$	9.9	square	= 30.2
		multiply by	0.22
first term	188.1		
second term	6.6	second term	6 64
sum	194.7 = difference of elevation in feet.		

The above formula is near enough for distances up to ten and fifteen miles, and will not differ by as much as a foot from the result of a rigorous formula; in fact it will keep within the limits of uncertainty of the refraction itself.

Table showing the height in feet corresponding to a given angle of elevation and a given distance in metres.

Metres.	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000
Angle.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
1′	0.3	0.4	0.6	0.6	0.8	0.9	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.5	2.7	2.8
2	0.6	0.8	1.0	1.2	1.5	1.7	1.9	2.1	2.4	2.6	2.9	3.1	3.4	3.7	3.9	4.2	4.5	4.7
3	0.9	1.2	1.5	1.8	2.2	2.5	2.8	3.1	3.4	3.8	4.2	4.4	4.8	5.3	5.6	5.9	6.3	6.6
4	1.2	1.5	2.0	2.4	2.8	3.2	3.6	4.1	4.5	4.9	5.4	5.8	6.3	6.8	7.2	7.6	8.1	8.6
5	1.5	1.9	2.4	2.9	3.5	4.0	4.5	5.0	5.5	6.1	6.6	7.1	7.7	8.3	8.8	9.4	9.9	10.5
6	1.8	2.3	2.9	3.5	4.2	4.8	5.3	5.9	6.6	7.2	7.9	8.5	9.1	9.8	10.4	11.1	11.7	12.4
7	2.1	2.7	3.4	4.1	4.8	5.5	6.2	6.9	7.6	8.4	9.1	9.8	10.6	11.4	12.1	12.8	13.5	14.3
8	2.4	3.1	3.9	4.6	5.5	6.3	7.1	7.9	8.7	9.5	10.4	11.1	12.0	12.9	13.7	14.5	15.3	16.2
9	2.7	3.5	4.4	5.2	6.2	7.0	7.9	8.8	9.7	10.7	11.6	12.5	13.4	14.4	15.3	16.2	17.2	18.1
10	2.9	3.8	4.9	5.8	6.8	7.8	8.8	9.8	10.8	11.8	12.8	13.8	14.9	15.9	16.9	17.9	19.0	20.0
11	3.2	4.2	5.3	6.4	7.5	8.6	9.6	10.7	11.8	13.0	14.1	15.1	16.3	17.5	18.6	19.7	20.8	21.9
12	3.5	4.6	5.8	6.9	8.2	9.3	10.5	11.7	12.9	14.1	15.3	16.5	17.7	19.0	20.2	21.4	22.6	23.8
13	3.8	5.0	6.3	7.5	8.8	10.1	11.4	12.6	13.9	15.2	16.6	17.8	19.2	20.5	21.8	23.1	24.4	25.7
14	4.1	5.4	6.8	8.1	9.5	10.9	12.2	13.6	15.0	16.4	17.8	19.1	20.6	22.0	23.4	24.8	26.2	27.6
15	4.4	5.7	7.2	8.6	10.2	11.6	13.1	14.5	16.0	17.5	19.0	20.5	22.0	23.6	25.0	26.5	28.0	29.5
16	4.7	6.1	7.7	9.2	10.8	12.4	13.9	15.5	17.1	18.7	20.3	21.8	23.5	25.1	26.7	28.2	29.9	31.4
17	4.9	6.5	8.2	9.8	11.5	13.1	14.8	16.5	18.1	19.8	21.5	23.1	24.9	26.6	28.3	30.0	31.7	33.4
18	5.2	6.9	8.7	10.4	12.2	13.9	15.7	17.4	19.2	21.0	22.8	24.5	26.3	28.2	29.9	31.7	33.5	35.3
19	5.5	7.3	9.1	10.9	12.8	14.7	16.5	18.4	20.2	22.1	24.0	25.8	27.7	29.7	31.5	33.4	35.3	37.2
20	5.8	7.7	9.6	11.5	13.5	15.4	17.4	19.3	21.3	23.3	25.2	27.2	29.2	31.2	33.2	35.1	37.1	39.1
21	6.1	8.0	10.1	12.1	14.2	16.2	18.2	20.3	22.3	24.4	26.5	28.5	30.6	32.7	34.8	36.8	38.9	41.0
22	6.4	8.4	10.6	12.6	14.9	17.0	19.1	21.2	23.4	25.5	27.7	29.8	32.0	34.3	36.4	38.5	40.7	42.9
23	6.7	8.8	11.1	13.2	15.5	17.7	20.0	22.2	24.4	26.7	29.0	31.2	33.5	35.8	38.0	40.3	42.5	44.8
24	6.9	9.2	11.5	13.8	16.2	18.5	20.8	23.1	25.5	27.8	30.2	32.5	34.9	37.3	39.6	42.0	44.3	46.7
25	7.2	9.6	12.0	14.4	16.9	19.3	21.7	24.1	26.5	29.0	31.4	33.8	36.3	38.8	41.3	43.7	46.2	48.6
26	7.5	9.9	12.5	14.9	17.5	20.0	22.5	25.0	27.6	30.1	32.7	35.2	37.8	40.4	42.9	45.4	48.0	50.5
27	7.8	10.3	13.0	15.5	18.2	20.8	23.4	26.0	28.6	31.3	33.9	36.5	39.2	41.9	44.5	47.1	49.8	52.4
28	8.1	10.7	13.4	16.1	18.9	21.5	24.2	26.9	29.7	32.4	35.2	37.8	40.6	43.4	46.1	48.8	51.6	54.3
29	8.4	11.1	13.9	16.7	19.5	22.3	25.1	27.9	30.7	33.6	36.4	39.2	42.1	45.0	47.8	50.6	53.4	56.2
30	8.7	11.5	14.4	17.2	20.2	23.1	26.0	28.9	31.8	34.7	37.6	40.5	43.5	46.5	49.4	52.3	55.2	58.2

Table showing the height in feet, &c.—Continued.

Metres.	300	400	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000
Angle.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
40	11.5	15.3	19.2	22.9	26.9	30.7	34.6	38.4	42.3	46.1	50.0	53.9	57.8	61.7	65.6	69.4	73.3	77.3
50	14.4	19.1	23.9	28.7	33.5	38.3	43.2	47.9	52.7	57.6	62.4	67.2	72.1	77.0	81.8	86.6	91.5	96.3
1° 00	17.2	22.9	28.7	34.4	40.2	46.0	51.7	57.5	63.3	69.0	74.8	80.6	86.4	92.3	98.0	104	110	115
1 10	20.1	26.7	33.5	40.1	46.9	53.6	60.3	67.0	73.8	80.5	87.2	93.9	100.7	107.5	114.3	121	128	134
1 20	23.0	30.5	38.3	45.8	53.6	61.2	69.0	76.6	84.2	91.9	99.6	107.3	115.1	123	131	138	146	154
1 30	25.8	34.4	43.0	51.6	60.3	69.0	77.7	86.1	94.7	103.4	112.0	120.7	130	138	147	155	164	173
1 40	28.7	38.2	47.8	57.3	66.9	76.6	86.3	95.6	105.2	115	124	134	144	153	163	173	182	192
1 50	31.6	42.0	52.6	63.0	73.6	84.2	94.9	105.2	115.7	126	137	147	158	169	179	190	200	211
2 00	34.4	45.8	57.4	68.9	80	92	103	115	126	138	149	161	172	184	195	207	218	230
2 30	43.0	57.3	71.7	86.0	100	115	129	144	158	172	186	201	215	230	244	259	273	287
3 00	51.6	68.8	86.2	103.2	120	138	155	172	190	207	224	241	259	276	293	310	328	345
3 30	60.2	80.4	100.5	120.5	141	161	181	201	221	241	261	281	302	322	342	362	382	402
4 00	68.9	91.8	114.8	137.7	161	184	207	230	253	276	299	322	345	368	391	414	437	460

CHAIN.

However frequent may be the number of bases furnished by the secondary triangulation, and however serviceable as a substitute in the measurement of distances the telemeter may have proved itself, we cannot entirely dispense with the chain; and as the circumstances under which its use is rendered necessary are mentioned elsewhere, it is only requisite to give a short description of the one employed in the Coast Survey. It is twenty metres long, and consists of that number of pieces of stout iron or steel wire, each piece or link being exactly one metre in length, and connected at either end with the next by being bent into an eye, through which passes a ring connecting it with the eye of the following link. For convenience of carriage these links are subdivided into lesser ones in some chains; but the advantage resulting from this is questionable, as the rupture almost invariably occurs at the joints, and multiplying them of course increases the liability to breakage; besides, the "kinking," or tendency to overlap or double, is also increased in proportion to the number of joints. On the other hand, it may be said that the bending of the links is decreased in proportion to their shortness.

At each extremity of the chain is a large ring, which slips over a staff held in the hand of the chainman, and rests upon a projecting rim of the pointed iron shoe at its base. The centres of these rings at the ends of the extended chain are the extremities of a line of twenty metres, and the points at which the pins should be inserted during the chaining.

As the strain constantly exerted upon the chain to straighten it must finally lengthen it by the "giving" of the rings, or as it may at times be shortened when the links are bent by being drawn over fences, rocks, or other unyielding obstructions, it is well to test it occasionally by a careful verification. Grave difficulties have arisen where dependence has been placed entirely upon long chained distances from a neglect of this source of error.

Adjusting screws are attached to the terminal rings of some of the chains, by which any error of length can be corrected. If a line of great length has been measured by an incorrect chain, the error in the line should be ascertained from the known error of the chain, and the plotted line corrected accordingly.

Each chain is accompanied by the usual number of pins, and a spring wire triangle for carrying them. The pins are also made of stout wire, about 18 inches long, pointed at one end, and bent into a ring at the other. It is well to attach white cotton or red flannel rags to the ring of each pin, that the rear chainman may distinguish it more readily in high grass, marsh, bushes, &c., and also at the ends of the five, ten, and fifteen metre links of the chain, for facility in counting. These rags should be changed as they become soiled.

Care should be exercised in the selection of intelligent chainmen, since it is often upon the precision of their work that the correctness of the survey in a great measure depends, and it is not always convenient or practicable for an assistant to accompany them. The better man of the two should be placed at the rear end of the chain, as he is the most responsible, and the forward man should implicitly obey his instructions. In all important places, however, such as closely settled districts, villages, and towns, in the measurement of base lines or distances upon which anything of mark may depend, an aid should go with the chain and check the records of the men.

When chaining is done in connection with the plane-table and the station is reached, the chain should be drawn sufficiently beyond and clear of the table to be out of the way, so that if more chaining is contemplated it does not have to pass the legs of the instrument.

With the class of young men usually employed as chainmen in the Coast Survey parties, it has been found safe and serviceable, after a little experience, in the absence of an aid, to have the rear man keep a chain-book, in which he notes all the crossings of high and low water, intersections of brooks, fences, roads, &c., with rectangular offsets to all reasonably accessible points on either hand, including bottom and tops of slopes, the record of tallies, and such other matters as may be needed, and may serve to assure accuracy in case of unfavorable intersections.

It is the habit with some, in obtaining short distances to comparatively unimportant objects, to trust to pacing, and practice enables one to ascertain thus the distances sufficiently close for plotting on a $\frac{1}{10000}$ scale, but these distances should never be great, and the topographer should be well assured of the accuracy of the pace. The use of the telemeter, however, may take the place of this method.

All distances to objects on either side of the chain line should be taken by offsets at right angles to it, and the book of the aid should, as far as possible, be held so that the line drawn as his guide in sketching should be in the same direction as the chained line itself, the better to enable him to draw his objects in their true relative positions.

Where great accuracy is necessary the length of a gradual slope may be measured and the angle of inclination taken with the vertical arc, with repetitions, and the measurement made reduced to the horizon by means of the following formula:

Let y be the length of the line measured upon the slope, δ its angle of inclination, and x its length reduced to the horizon; then—

$$x=y\cos\delta.$$

The excess of y over x may be computed by the formula, $y-x=2y\sin^2\frac{\delta}{2}$

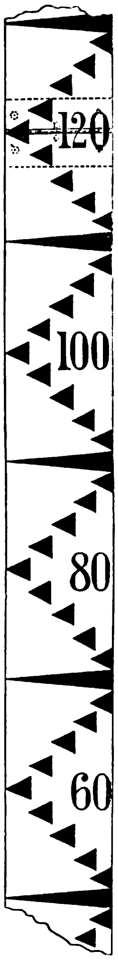
On very large scales, when parts of a metre are perceptible, Payne's tape, consisting of a narrow steel ribbon, which can be marked for minute distances, has been employed to advantage. It is convenient, also, for rapid reconnaissance in military surveys, and has been used under fire almost at double quick. Under these circumstances three men were employed, the usual back and forward chainman, with another to stand by the pins when stuck until about half the chain had passed, then, by pointing to indicate the position of the pin to the back chainman, and run forward in time to find, without difficulty, the forward pin, and also to change the pins at each tally. This tape will not stand as rough handling as the chain, and cannot be repaired in the field when broken, while the latter can lose one or more of its links and still be of service. The easy obliteration of the marks measured upon it by attrition has also been found a source of difficulty. All things considered, however, it is a very useful, compact, and handy instrument.

Many instances showing the remarkable accuracy with which the chain can be employed with the plane-table might be given from the reports of the officers of the Coast Survey; but it must be remembered that it is only to be used when other means are impracticable.

TELEMETER.

In consequence of some of the disadvantages resulting from the employment of the chain, among which are the necessity of frequent dependence for correct distances upon the chainmen, the number of persons required, the time consumed in its management, and the impediments to its use found in the features of some sections of country, another instrument, styled the telemeter, has been advantageously introduced in the topographical work of the Coast Survey.

It appears that instruments of this class were at first generally regarded by scientific men as merely ingenious inventions, and not as valuable in most respects as the ordinary method of chaining, the filling in of details forming a principal exception. From the experience of its use by the officers of the Coast Survey, however, it has been satisfactorily ascertained that the rapidity with which the details of a survey can be determined and sketched, the smaller number of men necessary to be employed, so that whatever errors may occur rest with the observer only, and the facility in using it in places where the use of the chain is impracticable, or at best difficult, render the telemeter a very important acquisition. It is not considered that it will ever entirely supersede the chain as a measuring instrument, but it is undoubtedly a facile and useful substitute under certain conditions.



The telemeter, as used in the Coast Survey, is simply a scale of equal parts, painted upon a wooden rod about 10 feet long, 5 inches wide, and $1\frac{1}{4}$ inch thick, so graduated that the number of divisions upon it, as seen between the upper and lower horizontal wires of the telescope, is equal to the number of units in the distance between the observer's eye and the rod held at right angles to the line of sight.

In all cases the telemeter should be graduated experimentally for the particular instrument and eye of the observer who has it in use.

The horizontal wires in the diaphragm of the telescope should be accurately adjusted, and the divisions of the telemeter made to correspond in length with the distance included between the upper and lower wires of the telescope at a carefully measured distance, and then divided into as many equal parts as there are units in the distance measured.

For convenience of transportation it can be hinged in the middle, and secured on the side when in use by a sliding bolt; and as it is necessary, when observed upon, that it should be held accurately at right angles to the line of sight, a small brass movable bar, with sights or a groove upon its upper edge, should be fixed upon theside of the rod at a convenient height for the eye of the rodman, and which, when in position, will be perpendicular to the plane of the telemeter and directly in the line of sight of the telescope.

The correctness of the telemeter depends upon the closeness of the reading, and the accuracy with which the rod is held perpendicularly to the line of sight.

With ordinary care an error of reading should not occur even at the greatest distance denoted on the rod. With the observations carefully made, and the reading of the rod reduced to a horizontal plane, the greatest distance given by it—as usually divided, can be relied on as practically correct. There is no sensible error at any distance greater than 20 metres and less than 260, and, generally speaking, the telescopes of the Coast Survey alidades have not sufficient reading power beyond 400 metres, but it will generally be safe to rely upon it for any distance from 15 to 500 metres, beyond which it cannot be read with accuracy for use in constructing a map on a scale of $\frac{1}{10000}$.

The telemeter has been recommended for use in a great variety of cases where it becomes necessary to determine distances, in such close filling in as the corners of streets, wharves, &c., determination of all classes of detail, in traverse, shore line, and even the establishment of positions, but in the latter it is safe only to depend upon good intersections. It has been employed, however, in all manner of detail, and is preferred by some to the chain, in all cases save on long lines, where the distances are so great that the telescope will not admit of the accurate reading of the rod, and it is maintained by some that where only a single point is to be seen positions can be readily and accurately determined.

For the reduction of the hypothenuse to the base, the following table is given :

Table for reduction of hypothenuse to base.

Angle.	Hypothenuse.				
	100 metres.	200 metres.	300 metres.	400 metres.	500 metres.
5°	99.62	199.24	298.86	398.48	498.10
10°	98.48	196.96	295.44	393.92	492.40
15°	96.59	193.19	289.78	386.37	482.96
20°	93.97	187.94	281.91	375.88	469.85
25°	90.63	181.26	271.89	362.52	453.15
30°	86.60	173.21	259.81	346.41	433.01
35°	81.92	163.83	245.75	327.66	409.58
40°	76.60	153.21	229.81	306.42	383.02
45°	70.71	141.42	212.13	282.84	353.55

RECONNOISSANCE.

The term reconnaissance as applied to topography, is a somewhat indefinite one, or rather it might be said it is very comprehensive. When there is any deviation from the closest attainable accuracy in a finished plane-table sheet, it becomes, strictly speaking, a reconnoissance map, and the rudest sketch of a country in which the features are delineated in rough approximation, which for certain temporary purposes is all that is needed, is likewise so called, so that in executing this kind of work with the plane-table there is much left to the judgment of the topographer. The amount of accuracy and closeness of detail required depends solely upon the object for which the survey is undertaken and the time and expense allotted to its completion. It is always best, however, to strive for the greatest precision which the circumstances will allow, particularly as the sheet may at some future time become available for other objects than that originally intended.

To the practical surveyor it is unnecessary to give any rules for his guidance, as his knowledge of the plane-table and of the requirements of the special work which he is called upon to perform will enable him to execute it promptly and satisfactorily. To the beginner, however, a few words on this subject, together with a statement of some of the results of the work accomplished by the Coast Survey officers, may not come amiss.

The recent war has shown in a forcible manner how little accurate information there was with respect to the topography of the interior of many of our middle and southern States, and the want of a sufficient number of topographers in the regular army was supplied, in answer to the calls of the War Department and various generals in the field, from the Coast Survey; and in almost every field of operations from the commencement of the war to its close, the plane-table was used.

Until this time very little was known, save in theory, of the value of the plane-table as a reconnoitring instrument, and it is the testimony of all the officers of these parties, as the result of their labors, that for rapidity and accuracy in the execution of military reconnaissance it is more effective than any other instrument.

The usual system adopted, in default of triangulation, was the measurement of a base with an ordinary chain and triangulating with the plane-table.

In detailed surveys for the army, where a topographer averages about a square mile a day, a chained base of from one-half to three-quarters of a mile for the survey of an area of twenty-five square miles, is found sufficient.

At Chattanooga, from two different bases of about half a mile each, plotted on separate sheets, and measured once carefully with the common 20-metres chain, the same chain being used for both measurements, after considerable intermediate plane-table triangulation carried on by two officers, two objects were determined two and a half miles apart, common to both sheets, which were on a scale of $\frac{1}{10000}$, and the discrepancy was but about 15 metres. Many other points of junction indicated this to be the maximum error. In this case the leaves were mostly off the trees, and the hills afforded good points. The sheets covered about 20 square miles each. At Nashville there was a discrepancy of about 10 metres in two miles. This would not do, of course, in finished work, but it is very close under the circumstances.

At other times, when the character of the country or the pressure of time did not admit of the measurement of a preliminary base and topographical triangulation, the work was commenced by starting from a single point, and prosecuted by linear measurement with the chain, intersections from the ends of the chained lines being taken to determine objects, which, as the work progressed, could also be used as checks upon the chaining. Where circumstances permitted, an occasional return with the chain to a back point, either to close a series of lines upon it or to start afresh, was resorted to. This work was generally carried on over roads, and the interior filled in by sketching and intersections, as far as practicable. Some of the tests in this latter work, where the operations of two officers joined, were remarkably close.

A very efficient topographical officer estimates that with the usual number of hands and a good sketcher for aid, in a country of average variety of detail, in which all the houses, prominent barns and out-buildings, streams, roads, general outline of woods, and approximate curves are to be shown, on a scale of $\frac{1}{10000}$, an area of between two and three square miles can be filled in daily, with not only sufficient accuracy for military purposes, but so that an accustomed eye with "the map in hand would not discover any marked discrepancy."

This rapidity of work, however, could not be expected in or near towns or populous districts. It is doubtful if the average work would reach more than one-half this amount.

In some thickly wooded sections, and where time is limited, it has been found advisable to run the main

roads with the plane-table, and fill in with the compass, which is more rapid but less accurate than where the entire work is done with the plane-table alone. The usual method employed, where these instruments were combined, was as follows: Where the army was stationary, or moving leisurely, one main road was run with the plane-table, the operator being accompanied by assistants well practiced in the use of the compass. Upon arriving at any important road or water-course, an assistant was sent to the right and left, starting from a plane-table point, determined by the chaining, and running as far as was requisite and then returning to the main road again to repeat the operation, the compass notes, of course, being kept in a book prepared for the purpose. Prominent points determined by the plane-table were used as checks in the compass work. The intervening topography, where no compass or plane-table work had been done, was sketched in by the chief of the party, in which accurate pacing became of great service.

OFFICE WORK.

All the drawing of the topographical features of a survey upon the chart should be pencilled in the field, while they are still under the eye. Sketching and plotting in the office from notes, unless the country be near at hand for ready reference in case of doubt or a defective sketch, is objectionable. Where this is unavoidable the sketch should be transferred to the sheet as soon as possible after having been taken, while it is fresh in the mind of the person by whom it was made, and by whom, also, if possible, it should be plotted. Days which, from inclemency of the weather, are unfavorable for out-of-door work, should be allotted to this purpose, and advantage should be taken of them, also, for retouching any details of the sheet which may have become indistinct, as it is very important that they should not be left indefinite or become obliterated; for when the inking is done, as it generally is, at a distance from the field of operations, the necessity for this care is obvious. Nos. 4 and 5 pencils are good for this purpose, for which very hard or very soft and black pencils are equally unsuited.

In the inking of a topographical sheet three requisites to its proper appearance when finished should be borne in mind: clearness, neatness, and uniformity.

The lines and objects should be clean and sharply defined, nothing being left obscure or doubtful; the paper should be kept unsoiled, and erasures avoided as far as possible, and the style and strength of the drawing should be the same throughout. It is an important matter that an easy and natural appearance should be given to the map, for, as before remarked, a mere rigid adherence to conventional signs is not all that is necessary; while there should be no deviation in this respect, at the same time the draughtsman should strive to *represent the country*. There is a great difference with regard to this among topographers. Two perfectly correct charts of the same section of ground, executed by different persons, may be inked, and while one will have a stiff and ungraceful look, the other will appear artistic and natural, giving at once the impression of a sincere representation of the country surveyed.

Office work should not be commenced until the topography is entirely completed, as no inked or partially inked chart should ever be used in the field. Sometimes, for the special examination of old work, or for the insertion of some recent artificial or natural changes, this becomes necessary. There is always a risk of injuring an inked map by exposure to the weather or by using it upon a plane-table.

The inking should commence with the shore-lines, high and low water. The high-water, or shore-line proper, should, in all cases, be full and black, the heaviest lines on the sheet, and in this, as in all the rest of the ink-work, the lines of the survey should be strictly adhered to.

The topography as drawn in the field is supposed to be correct when the chart is finished, and no office amendments or changes are admissible. The low-water line is next drawn, not so full as the former, but clear, black, and uniform, consisting of a dotted line for sand and mud, and the conventional sign where it is formed by shells, rocks, or coral reefs.

Grass upon flats, or shoals covered at high tide, have no distinct continuous line to mark their limits, each being represented in its proper form and within its area by its conventional sign only, but the shape should be well and correctly defined. All objects between high and low water, covered at full tide, should be represented less boldly than the rest of the map, but not faintly or indefinitely.

The roads should next be inked, plainly and evenly, and their sides parallel, except where the survey shows a deviation from the general width. Where a road is fenced the fence should be shown by the usual sign, and where there is no enclosure a dotted line should indicate the road-side, and then should follow the fences and houses. In drawing the latter care must be taken that the corners and angles exhibit a sharp, clear outline, which adds much to the appearance of the map.

The general skeleton of the survey being now completed the contours are drawn with a bold, uniform, plain red line, without break, over all the other work, following accurately the full range of level of each of the contours on the sheet.

After this comes the general filling in, by conventional signs, of sand, marsh, grass, cultivation, orchards, rocks, hachures, &c. Some practice is needed to execute the sand-work regularly and neatly. It should never be hurriedly done, though, of course, rapidity in this respect follows practice. The lines representing marsh, and the delineation of grass on the fast land, should always run in the same direction over the whole sheet, and be parallel to the top of the sheet and the title. The appended drawing (Sketch No. 32) gives the conventional signs as adopted by and now used in the Coast Survey.

The most difficult part of the inking for a beginner is the lettering, which now follows, and for which samples are given, (Sketch No. 32.) It is expected that every topographer shall have learned to draw sufficiently well to ink his sheet in a clear and distinct manner, and letter it with some regard to neatness and graphic effect, as the appearance of an otherwise well-inked sheet is sometimes marred by careless or indifferent lettering.

The location of the names upon the sheet should be such as not to cover or obliterate any detail or feature of the survey, and the letters should be put in neatly and gracefully, and in point of size and form according to the specimens furnished. The title should finally follow, with such notes as may be necessary to explain any peculiarity of the sheet or survey. This title and lettering should, as far as practicable, be so placed that when the sheet is held with the top (usually the north or east end of the map) from you it can be easily read; in other words, as nearly parallel to the top or upper end of the sheet as the nature of the work will admit. All names well established and recognized in a neighborhood, both general and local, should be collected during the survey, and their correct orthography ascertained, and, in case of any doubtful or disputed orthography, a report should be given of any traditions or any authorities which may bear upon the subject. No illuminated or German text, old English, or what is known as "fancy printing," should be indulged in, a strict adherence to simplicity being the greatest ornament.

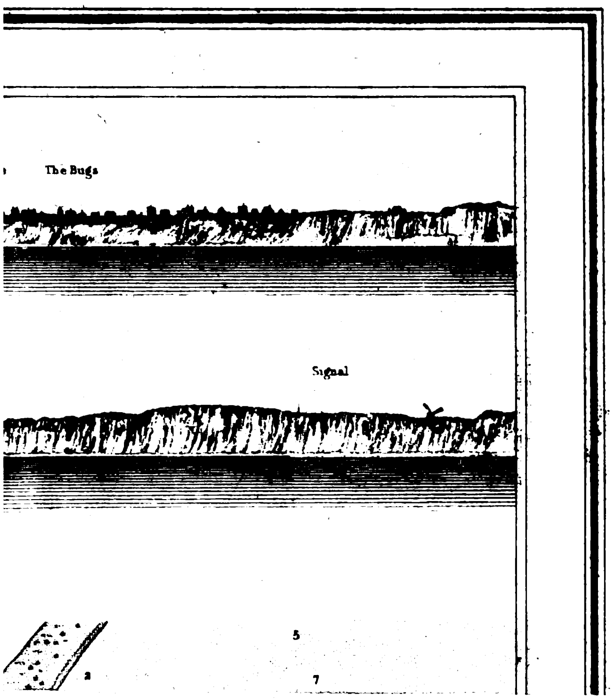
The minutes of the parallels of latitude and meridians of longitude should be marked in figures at the upper and right-hand ends, respectively, the degrees on the centre parallel and centre meridian only.

Where the buoys are determined by the topographer, and their names, colors, numbers, or kind are known they should be lettered upon the map.

The triangulation points should also be lettered, first being surrounded by a small circle. The magnetic meridian should be drawn with a half fleur-de-lys at its head, and the true meridian, where no projection is used, with a full one.

LIST OF SKETCHES.

No. 1. A. Progress Sketch, Section I. Primary triangulation.
2. A *bis*. Progress Sketch, Section I. Topography and hydrography.
3. St. George's river and Muscle Ridge channel.
4. Damariscotta river.
5. Kennebec and Sheepscot rivers.
6. Coast, from Small Point to Cape Cod, (new edition.)
7. Nantucket harbor, (new edition.)
8. Providence river, Rhode Island.
9. New York bay and harbor, (new edition.)
10. Barnegat inlet, New Jersey.
11. Delaware and Chesapeake bays, (new edition.)
12. Cape Lookout shoals.
13. Cape Fear River entrances.
14. Charleston harbor, (new edition.)
15. Coast of South Carolina.
16. Mississippi river, sheets 1 and 2.
17. Mississippi river, sheets 3 and 4.
18. Mississippi river, sheets 5 and 6.
19. Tennessee river, (diagram.)
20. Mississippi sound.
21. Progress Sketch, No. X.
22. Pacific coast, Point Pinos to Bodega Head.
23. Half-Moon bay, (to be printed in three colors.) Omitted.
24. Koos bay.
25. General Progress Sketch.
26. Tidal diagram—Pacific coast.
27. Magnetic chart of the United States, for 1870.
28. Secular change—magnetic declination.
29. Magnetic instruments.
30. Plane-table.
31. Diagrams for Appendix No. 22.
32. Specimen of plane-table sheet.


The Bugs
Signal
5
7

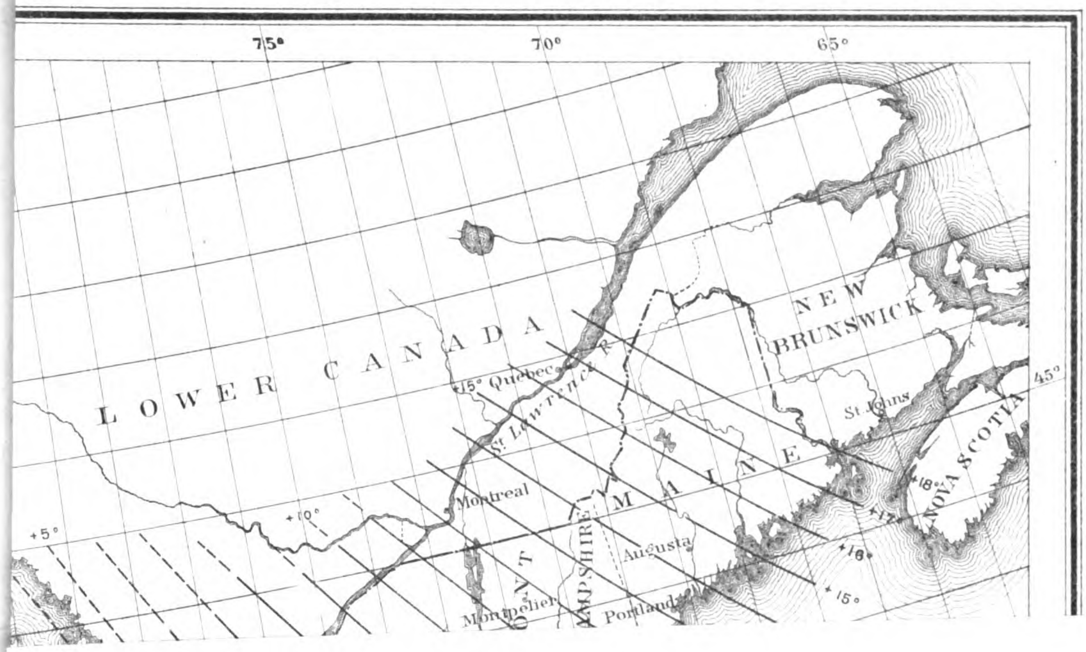
14

25

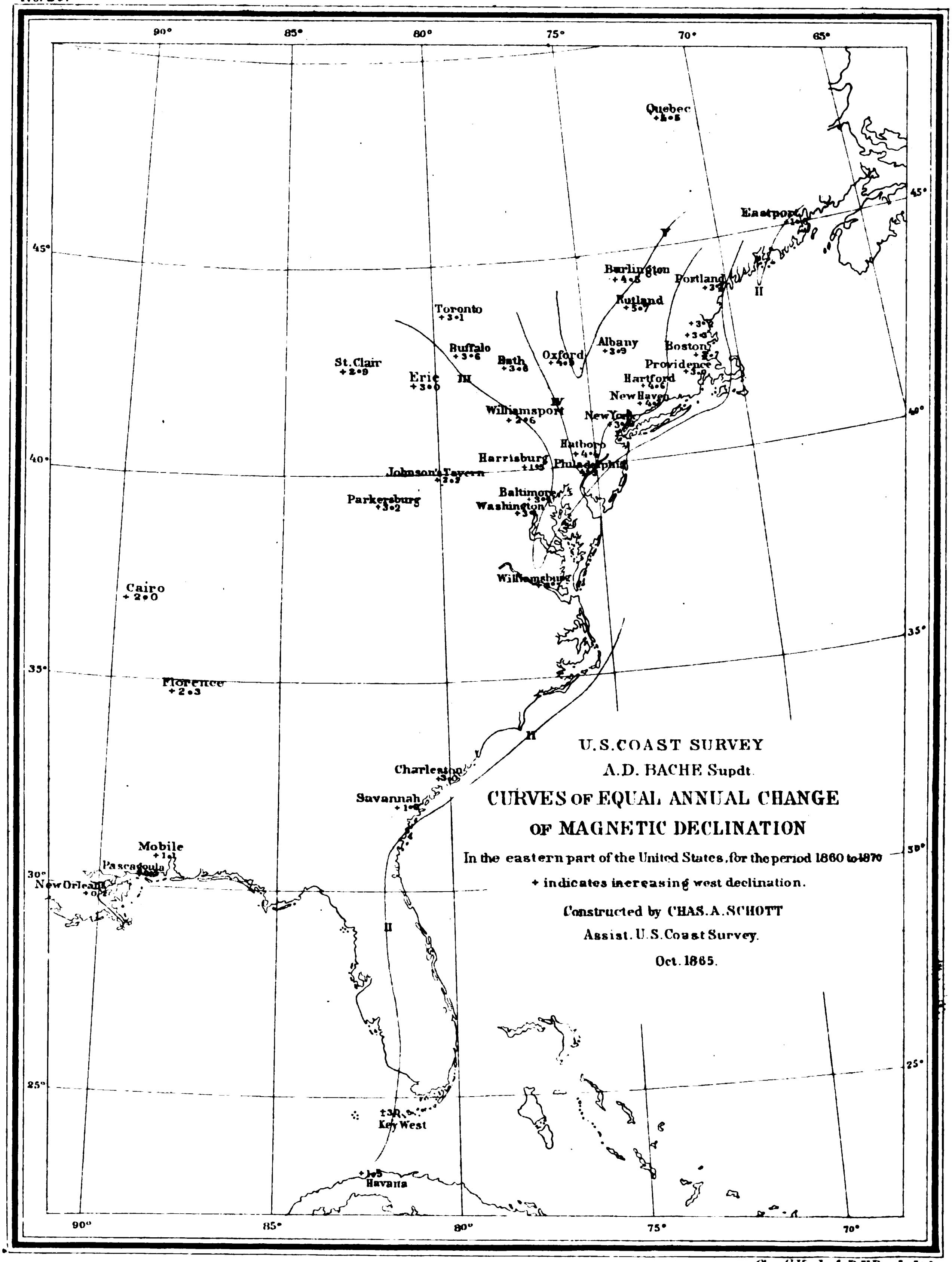
H

Feet

he year 1870.

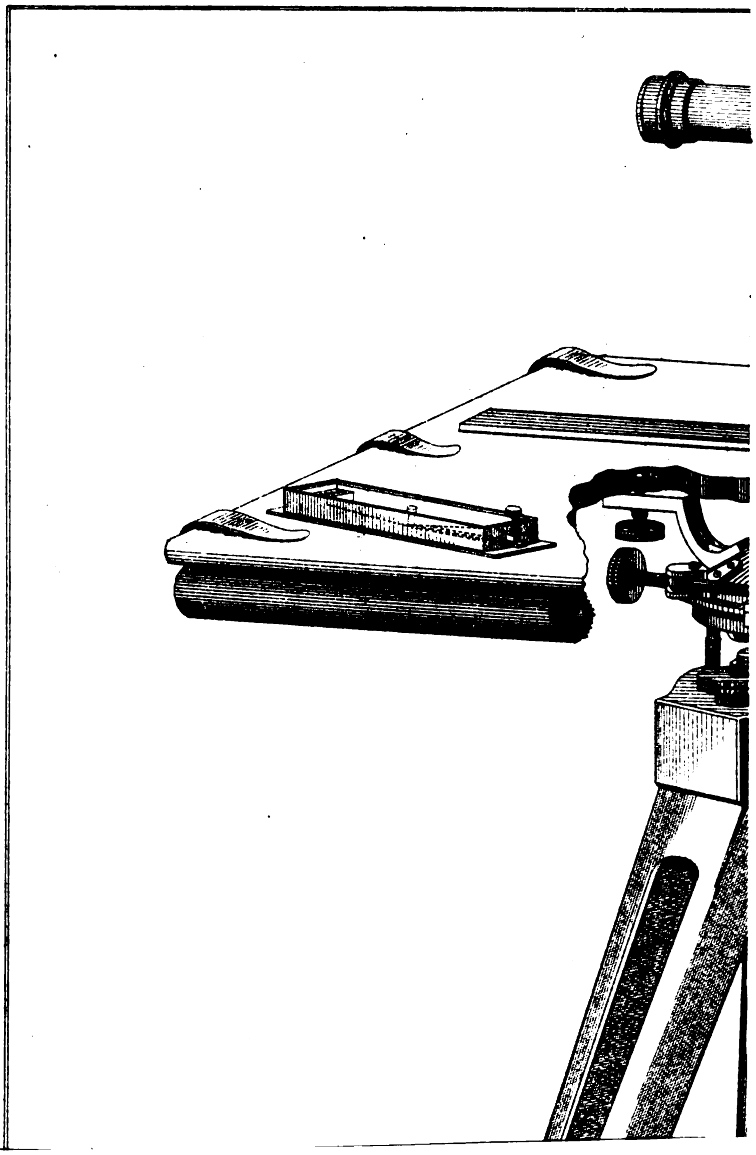

75°
70°
65°
45°
LOWER CANADA
NEW BRUNSWICK
NOVA SCOTIA
MAINE
+15° Quebec
Montreal
Montpelier
Augusta
Portland
St Johns
+5°
+10°
+18°
+17°
+16°
+15°

No. 28.



Chas G Krebs & R.F. Bartle, Lith

No. 30.



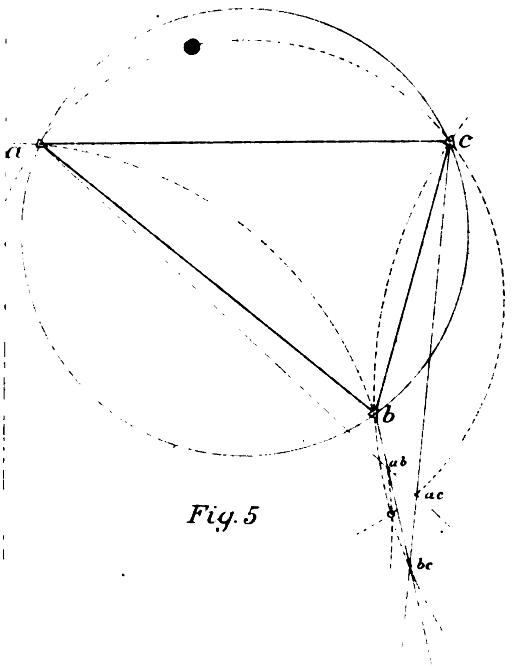


Fig. 5

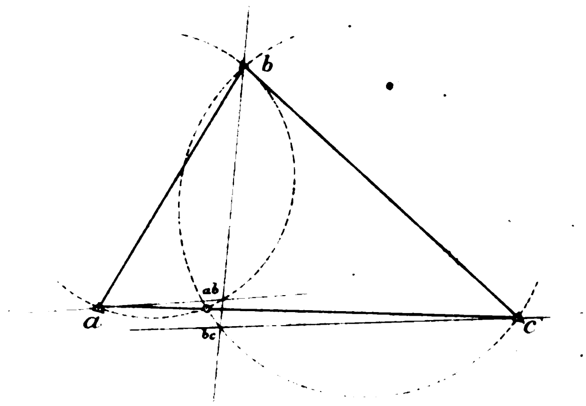


Fig. 6

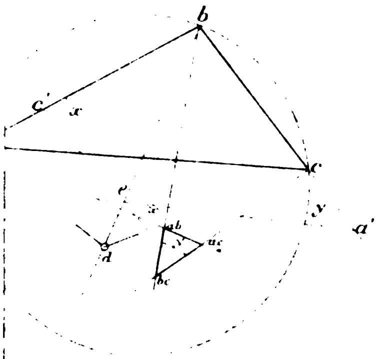


Fig. 12

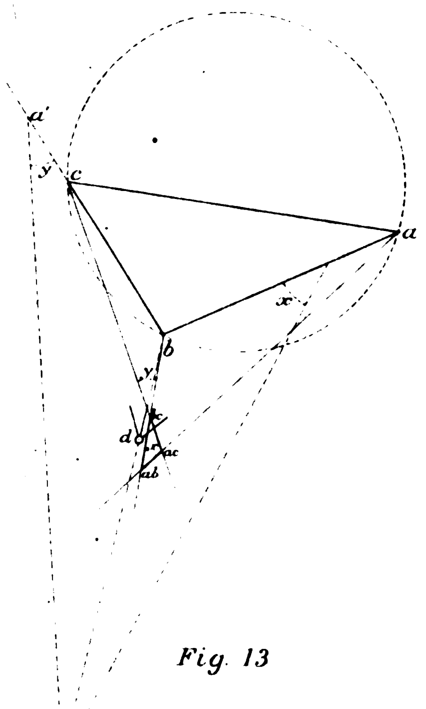


Fig. 13

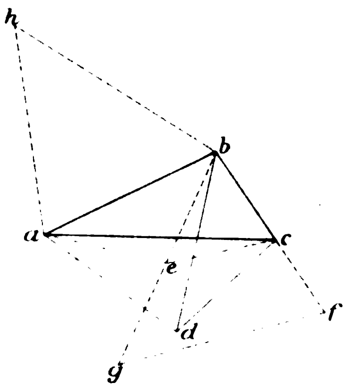


Fig. 14